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General Cropland Retirement: Retiring Low-Net-Return Acreage vs. Retiring High-Cost Production

By Glenn A. Zepp and Jerry A. Sharples

The probable outcome of a general cropland retirement program based on retiring land having the lowest net return per acre is compared with the probable outcome of a program based on retiring land having the highest unit production costs. Estimates are made of (1) location of the retired cropland, (2) cost to the Government, and (3) impact on production potential after retiring different amounts of cropland nationally with the two programs.

Key words: General cropland retirement, farm programs.

The 1956 Conservation Reserve Program imposed a ceiling on per acre retirement payments. This tended to cause cropland retirement to be concentrated in areas having relatively low net returns per acre.

But retiring cropland having the lowest net return per acre may not be the cheapest means for the Government to obtain reductions in farm production. To achieve this latter objective, that cropland should be retired on which the greatest amount of production is retired per dollar of payment.

This paper describes an analysis of two general cropland retirement programs based on different criteria which the Government could use in selecting cropland for retirement. Both criteria retire cropland and production but the emphases differ. The criteria are:

(1) Retirement of low-net-return acreage, hereafter referred to as the "acreage criterion." With this criterion, the Government seeks to retire that cropland which it can obtain for the lowest cost per acre. It retires the maximum amount of cropland for a given program expenditure.[1]

(2) Retirement of high-cost production, hereafter referred to as the "production criterion." With this criterion, the Government seeks to retire that cropland on which it can obtain the greatest reduction in production per dollar of Treasury cost. Cropland which has the highest ratio of gross receipts to net returns is retired before any cropland having a lower ratio.[2]

The following example of a wheat budget and a cotton budget illustrates the difference between the two criteria:

Item	*Wheat*	*Cotton*
Value of production per acre	$25.00	$150.00
Variable cash costs per acre	15.00	100.00
Net returns per acre	10.00	50.00
Value of production, per dollar of net returns	2.50	3.00

In this example, wheat has a net return per acre of $10, while cotton has a net return per acre of $50. Using the acreage criterion, the Government would choose to retire the wheat acre before the cotton acre because the wheat acre could be obtained for a smaller payment. But in this example, the value of production per dollar of net returns is $2.50 for wheat and $3 for cotton. Using the production criterion, the cotton acre would be retired first because more production (in value terms) is retired per dollar of program cost than for wheat.

The effects of the different retirement criteria are examined in this study by comparing short-term estimates of (1) the amount and location of cropland

[1] In this analysis, net receipts were assumed to be a proxy for payments which would be required to retire cropland from production.

[2] To make intercrop comparisons, the unit of production was $1 of gross receipts.

retired, (2) remaining production potential after retiring a given amount of cropland, and (3) total Treasury costs.

Analytical Procedure

Two general cropland retirement programs, similar in all respects except in the criterion used to select land for retirement, were assumed to be offered to farmers. With either program, farmers were assumed to be able to participate on a part-farm (individual crop) retirement basis. The programs were assumed to be operated on a national bid system. Under such a system, each farmer competes with every other farmer in the country for participation in the program. The only cropland accepted for retirement was that on which the payment rates were most favorable to the Government, using the appropriate criterion. Cropland retirement in any given county was assumed to be limited to 30 percent of the total cropland (irrigated and nonirrigated) in that county. Such a restraint is likely to be included in any cropland retirement program, to reduce the impact on some areas which might have high participation rates. There was no limit on total program payments to an area.

The United States was divided into 10 production regions (fig. 1). Most regions were subdivided into smaller, more homogeneous production areas. The analysis consisted of 100 production areas in all.

Retirement was assumed to be from a "normal" acreage defined as the planted acreage of 15 major crops in recent years.[3] In addition, land diverted from feed grains, cotton, and wheat production in the past was treated as normal acreage for these crops. Estimates of normal production were based on projected 1970 yields. Only nonirrigated cropland was assumed to be eligible for retirement.[4] An estimated 312 million acres of nonirrigated cropland were included in the analysis.

Farmers' expected net returns over variable cash costs were used as a proxy in this study for the payment necessary to get cropland retired. It was assumed that the minimum retirement payment would be $3 per acre per year. In addition to the retirement payment, all retired land was assumed to receive a $2-per-acre annual payment to cover costs of conservation practices. The minimum payment that any participant would receive, therefore, was $5 per acre per year.

Net returns for each major crop in each of the 100 production areas were estimated from Economic Research Service budget data.[5] A total of 568 crop net return estimates were developed for the analysis. Since the study was concerned with part-farm retirement, net returns were computed as those over variable cash costs rather than over total cost. No charge was made for land costs, operator and unpaid family labor, or machinery depreciation. Estimates of net returns were based on 1970 expected prices, costs, and yields. Estimates of farmers' expected market prices for major crops in 1970 were based on 1967 and 1968 market prices and expected 1969 prices. Prices used in the analysis were: Corn, $1.06 per bushel; wheat, $1.25 per bushel; oats, $0.62 per bushel; barley, $0.92 per bushel; sorghum, $0.99 per bushel; soybeans $2.15 per bushel; and cotton, $0.20 per pound.

The analysis was done with a simple accounting model. The model first selected the cropland to be retired using each criterion. Then the amounts of cropland and production potential retired were accumulated by region and by crop at different national retirement levels. Expected net returns and value of the potential production on retired acreage also were accumulated.[6] Acreages and production potential for each crop on the unretired cropland were estimated by subtracting retired acreages and production potential from normal acreages and production potential.

The analysis was not an equilibrium analysis. Prices of farm products were introduced only as farmers' expectations. The model only simulated a first-year response to a general cropland retirement program. Any supply-demand imbalance caused by land retirement in the first year is not fed back into the analysis.

Results

The results are highlighted in the accompanying figures and tables. Cost per acre of retiring land goes up sharply as more acres are retired (fig. 2). Retiring a given amount of land using the production criterion costs

[3]The crops are cotton, corn grain, corn silage, sorghum grain, sorghum silage, soybeans, barley, oats, winter wheat, durum wheat, other spring wheat, rye, flax, edible beans, and hay. Cropland planted to other crops was assumed not to participate in a land retirement program.

[4]Retirement of irrigated cropland without retirement of irrigation water would not have very much impact on crop production. The water could be diverted to other cropland, thereby increasing its production and offsetting the reduction in production from retiring the irrigated cropland.

[5]Budget data used in this study were developed by field staff personnel of the Farm Production Economics Division, ERS, for use in the Division's Aggregate Production Analysis System.

[6]The actual value of production depends on the market price which, in turn, depends on the amount of each crop produced. In this study, "expected" 1970 yields times "expected" 1970 prices were used as an approximation of crop values.

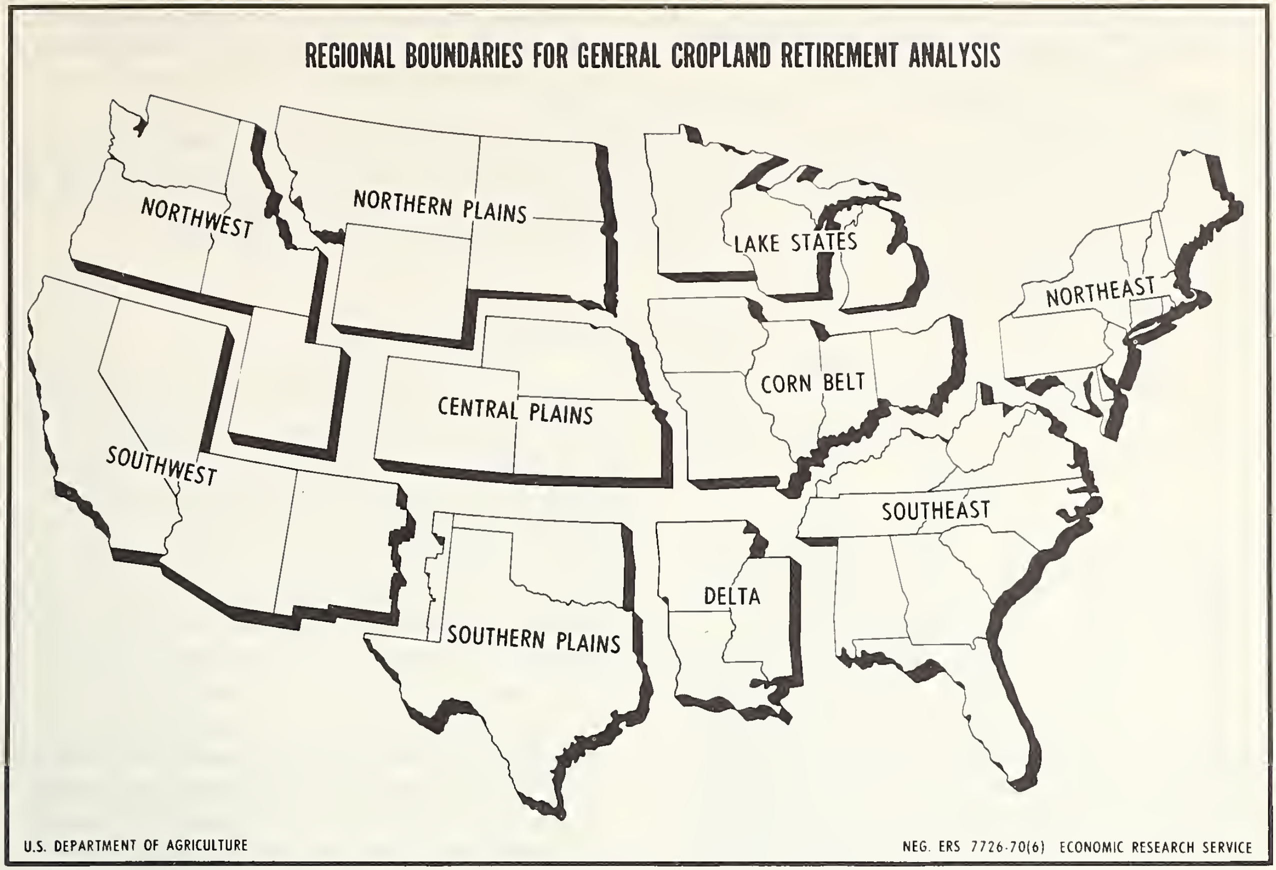

Figure 1

about twice as much per acre as retiring the same amount of land using the acreage criterion. If the objective of a general cropland retirement program is to maximize acres retired per dollar of program expenditure, the acreage criterion obviously does the better job.

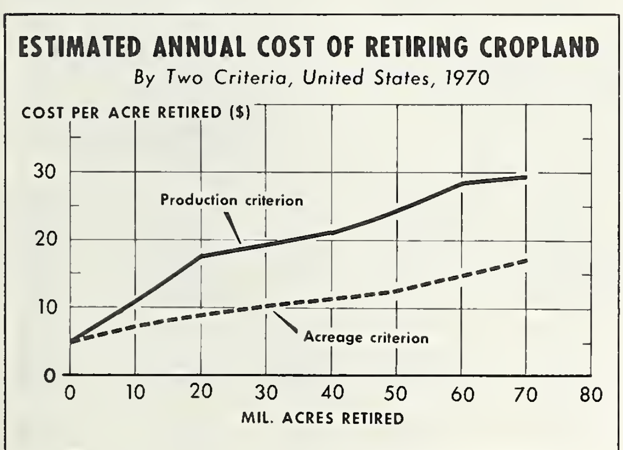

Figure 2

Figure 3 illustrates the relationship between the amount of production potential retired and the cost of retiring that production. For example, using the production criterion and retiring $500 million of production potential, the average cost of land retirement is only $0.21 per dollar of gross value retired. This average increases to $0.48 per dollar of gross value retired when retiring $2.5 billion of gross value. When using the acreage criterion, the average cost is $0.54 per dollar of production retired when retiring $500 million of gross value, and $0.58 when retiring $2.5 billion of gross value. If the major objective of a general cropland retirement program is to maximize production retired rather than acres retired, the production criterion obviously is the better one to use.

The two criteria are further evaluated by comparing Government costs for land retirement under three programs: (1) Retiring a given amount of cropland (50 million acres nationally), (2) retiring a given value of

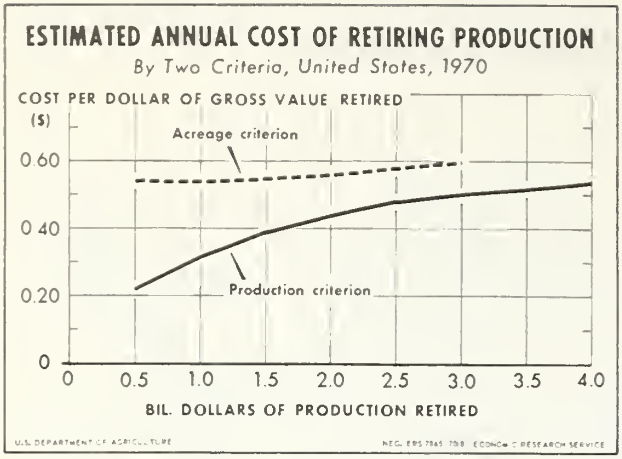

Figure 3

production ($2.5 billion), and (3) spending a given Government outlay ($1.25 billion) on retirement payments. The results are summarized in table 1.

Suppose a general retirement program were designed to retire $2.5 billion worth of production. The results indicate that a program based on the acreage criterion would require retiring about 50 percent more acres and a total Treasury cost about 20 percent higher than a program based on the production criterion. Thus, although the production criterion program has a higher cost per acre, it can obtain a given amount of reduction in production more cheaply.

Suppose an upper limit of $1.25 billion is placed on expenditures for a general cropland retirement program. Under the acreage criterion, 72 million acres or $2.2 billion of gross value can be retired for $1.25 billion; whereas under the production criterion only 50.7 million acres, but $2.6 billion of gross value, can be retired.

Payment rates per acre also differ substantially between the two criteria. For example, when 50 million acres are retired nationally using the acreage criterion, the average payment per acre is $12.60, and no acre receives more than $22. Using the production criterion, the average retirement payment per acre is $24.40, and the retirement payment on some cropland (primarily corn and cotton) is more than $50 per acre.

Cropland Retirement Pattern

There is a major difference in the regional distribution of retired land with the two retirement criteria. These differences are illustrated in table 2. Retired acres are more concentrated in small-grains producing areas such as the Great Plains under the acreage criterion than under the production criterion. For example, when 50 million acres are retired nationally, with the acreage criterion, 54 percent of the retired land is in the Northern and Central Great Plains. The Southeast and Delta States account for only 11 percent of the retired land at this level of national retirement. With 50 million acres retired nationally using the production criterion, only about one-fourth of the retired acres are located in the Northern and Central Great Plains. The remaining three-fourths are about equally divided among (a) the Southeast and Delta States, (b) the North Central States, and (c) the remaining regions. When more than 40 million acres are retired with the acreage criterion, land retirement in many Great Plains areas reaches its 30 percent maximum. Then most of the additional retirement comes from other regions, especially the Corn Belt, the Lake States, and the Southeast. This points out that most of the land with low net returns per acre is located in the Great Plains, and only after this low-net-return

Table 1.—Estimated annual total cost, cost per acre, and value of production foregone at three levels of land retirement under two retirement criteria, United States, based on estimated 1970 yields and prices

Item	Acreage criterion			Production criterion		
	50 million acres retired	$2.5 billion value of production foregone	$1.25 billion program cost	50 million acres retired	$2.5 billion value of production foregone	$1.25 billion program cost
Acres retired . . . . mil.	50.0	77.6	72.0	50.0	49.3	50.7
Total annual cost . . . . mil. dol.	630	1,444	1,250	1,220	1,190	1,250
Cost per acre . . . . dol.	12.60	18.62	17.36	24.40	24.12	24.64
Value of production foregone . . . . mil. dol.	1,180	2,500	2,219	2,540	2,500	2,596
Cost per dollar of gross value retired . . . . dol.	0.53	0.58	0.56	0.48	0.48	0.48

Table 2.—Regional distribution of estimated cropland acreages retired at four levels of land retirement nationally, under two retirement criteria, United States, based on estimated 1970 prices and yields

Region	Million acres retired nationally under acreage criterion				Million acres retired nationally under production criterion			
	10	30	50	70	10	30	50	70
	Million acres				*Million acres*			
Northeast	-	-	-	4.0	-	-	2.2	[a]4.0
Southeast	1.5	2.1	4.3	7.6	4.0	[a]8.2	[a]8.2	[a]8.2
Delta States	0.6	0.6	1.4	3.8	1.1	3.7	[a]4.2	[a]4.2
Corn Belt	-	-	2.5	6.4	-	2.6	8.7	18.1
Lake States	-	0.1	1.2	4.5	0.1	1.6	4.2	7.8
Northern Plains	2.3	10.1	13.6	14.4	-	3.2	5.8	8.2
Central Plains	2.1	9.4	13.2	14.2	0.1	2.0	5.2	6.1
Southern Plains	3.3	6.8	9.7	9.9	4.2	7.9	9.1	9.3
Southwest	0.2	0.2	[b]0.6	[b]0.6	0.2	0.2	[b]0.6	[b]0.6
Northwest	-	0.7	3.5	4.6	-	0.6	1.8	3.5
United States	10.0	30.0	50.0	70.0	10.0	30.0	50.0	70.0

[a]Indicates the 30 percent limit on land retirement within the region.
[b]Only 0.6 million acres of dryland cropland were assumed to be eligible for retirement in the Southwest.

acreage is retired and the payment rate increases, is more cropland retired in other regions.

Production Adjustment

The analysis can be used to give a rough indication of the acreage and production of crops that might be expected on the unretired land. These figures must be used with caution. In this study, acreage and production potential after retiring cropland are estimated by subtracting estimates of retired acres and production potential from projections of the 1970 "normal" acreages and production potentials. The analysis does not permit substitution of crops on the unretired land. The crop production figures are useful, however, to indicate some maladjustment problems that might arise if large quantities of cropland were retired.

Compared with the acreage criterion, the production criterion puts more emphasis on retiring corn and cotton production and less emphasis on retiring wheat production. With 50 million acres retired using the acreage criterion, production of feed grains and cotton is substantially higher than during recent years (table 3). Wheat and soybean production are less than recent use levels. When 50 million acres are retired using the production criterion, feed grain, wheat, and cotton production are nearer recent utilization.

The reason for this shift of retirement among crops is that, relative to other crops, wheat grown in the Great Plains has a low net return per acre. In the analysis using the acreage criterion, wheatland is some of the first to be retired. But our data show that Great Plains wheat also has a high net return per dollar of gross value relative to other crops. In the analysis using the production criterion, acreage having the highest ratio of gross value to net returns is retired first. Using this criterion, Great Plains wheat tends to be selected for retirement *after* corn and cotton acreage. Our data show that, in general, it takes a higher payment to retire $1 worth of wheat in the Great Plains than it does to retire either $1 worth of corn in the Corn Belt or $1 worth of cotton in the Cotton Belt.

Changing the Product Price Relationships

Commodity prices used in the analysis were assumed to represent farmers' price expectations. A change in any one of the commodity prices in the analysis changes the expected net returns for that commodity. Furthermore, a change in expected net returns causes a change in the payment needed to retire that acre. A large change in expected price for any one commodity could cause shifts in the regional location of retired acres from the patterns reported above. Crop production on the unretired land would also be affected.

The results reported above show that with 50 million acres retired under either criterion, feed grain production is much larger than recent utilization. With this in

Table 3.—Estimated production of major crops after 50 million acres are retired, United States, based on estimated 1970 prices and yields

Crop	1969 utilization[a]	Acreage criterion	Production criterion
Corn . . . . mil. bu.	4,667	6,152	5,305
All feed grains . mil. tons	176	214	190
Soybeans . . . . . mil. bu.	1,201	1,034	986
Wheat . . . . mil. bu.	1,380	1,029	1,205
Cotton . . . . . . mil. bales	10.7	14.2	11.5

[a]Preliminary estimate of domestic consumption plus net exports.

mind, feed grain prices were reduced 15 percent to determine the impact of a lower feed grain price on the production adjustment and the land retirement patterns of the two general cropland retirement programs. The national average corn price was reduced to $0.90 per bushel from $1.06 per bushel, and similar reductions were made for grain sorghum, oats, and barley. Prices of all other crops remained unchanged.

The results under both the acreage criterion and the production criterion show more feed grain acreage retired and less cotton and wheat acres retired when feed grain prices are reduced. There is still a production imbalance, however, between feed grains, cotton, and wheat when using the acreage criterion, similar to that which occurred with the higher feed grain prices. But, using the production criterion and retiring 50 million acres, corn production is reduced to 4.7 billion bushels; cotton production is 11.7 million bales; soybeans production is 1.0 billion bushels; and wheat production is 1.3 billion bushels. This production mix is close to the 1969 utilization.

Policy Implications

A major policy implication of this study is that crop production and the location of retired acres can be affected substantially by the criterion used in selecting which cropland to retire in a general cropland retirement program. Another policy implication is that, if a general cropland retirement program is to achieve the greatest possible reduction in production per dollar of program cost, there can be no very restrictive limit on per acre retirement payments.

One question which this study does not answer is, which criterion is the better? The answer depends upon the objectives of the program. How well do the two programs considered here achieve the following objectives: (1) Long-run resource adjustment, (2) maintenance of farm income, (3) minimizing Government costs of agricultural programs, and (4) minimizing the social and economic disruptions of the program on farming communities?

The acreage criterion, by definition, minimizes the Government cost of obtaining a given amount of land retirement, but this does not mean that the acreage criterion gives the most desirable pattern of permanent long-run resource adjustment. This question is receiving further study by the authors.

The production criterion, by definition, gives the greatest amount of reduction in production for a given Treasury expenditure. Consequently, the larger boost of farm prices and income can be obtained per dollar of Treasury expenditure using the production criterion. If a general cropland retirement program were to be the only method of retiring cropland from production, the results show that the production criterion would give a remaining production mix more in line with recent utilization levels.

The nonfarm sector of a community may have to bear the greatest adjustment burden of a general cropland retirement program. Landowners generally would be completely compensated for retiring cropland and giving up the income they might normally expect from their fixed investment. Agricultural supply, marketing, and service firms are not reimbursed in the same manner. If a general cropland retirement program substantially reduces farming activity in a given community, incomes to the nonfarm segments of the local economies are reduced—especially if farming is a major part of that community's economic base.

Compared with the acreage criterion, the production criterion tends to shift land retirement from the Great Plains to the Corn Belt and the Lake States. This geographical shift in land retirement may reduce the social and economic disruption of a general cropland retirement program. Agriculture provides a much larger proportion of the total economic base in the Great Plains than in other regions. For example, in 1968 personal income from farming was 10.1 percent of total income in the Great Plains, but only 2.6 percent in the Corn Belt and 2.5 percent in the Lake States.[7] Moreover, a high proportion of other income in the Great Plains is derived from the farm supply, marketing, and service industries whose business would be curtailed by a substantial amount of land retirement.

[7]U.S. Department of Commerce, Office of Business Economics. Survey of Current Business. Vol. 49, No. 8, Aug. 1969.

It also would be more difficult for Great Plains farmers to shift to off-farm employment because they do not have as many such opportunities as farmers do in other areas. A much higher proportion of the total income of farm families in the Great Plains is from farming than is the case in other major regions such as the Lake States, the Corn Belt, and the United States as a whole.[8]

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[8] Based on special tabulations by Internal Revenue Service for ERS.

Speculation in Commodity Futures: An Application of Statistical Decision Theory

By Samuel H. Logan and J. Bruce Bullock

A recursive, monthly price forecasting model for live cattle serves as a basis for applying decision theory to speculation in cattle futures. The distribution of predicted futures prices is obtained from the standard error of the forecast of the cash price forecasting model in conjunction with the historical distribution of the difference between futures and cash prices during the month of futures contract delivery. Baumol's expected gain-confidence limit model is utilized in determining which of the available futures contracts offers the highest minimum payoff potential holding the probability of at least such a payoff constant.

Key words: Cattle futures, speculation, price forecasting, decision theory, safety-first.

Speculation in commodity futures contracts, such as those for live beef cattle, has many of the attributes of gambling. The speculator, by selling or buying futures, is essentially betting that he knows better than the current market what future price conditions will be for a particular commodity. If both the speculator and the market were in agreement as to what the future price would be, there would be little incentive to speculate.

Like the roll of the dice or the turn of a card, the outcome of speculation in futures is uncertain. However, unlike the situation at the gaming table, the probabilities of the outcome on a speculative venture generally cannot be calculated precisely. And, unlike the gamble with the cards, two persons' computations of the odds of making a given profit or loss may not be identical. Indeed, subjective probabilities may be even more important in the decision criteria with respect to commodity speculation than those calculated mathematically.

With many commodities for which futures contracts are traded, statistical decision techniques can be used to generate additional information for selecting among alternative buy-or-sell actions. This paper demonstrates the application of statistical decision theory to speculation in live beef cattle futures. The general underlying theoretical model for this analysis was outlined in a previous issue of this journal (4).[1]

[1] Underscored numbers in parentheses indicate items in the References, p. 103.

The Problem

The futures speculator faces several alternative actions—he may sell short, anticipating a price decline, after which he buys back the contract; or he may "go along" by purchasing a contract in anticipation of selling it later for a higher price. These two actions are compounded by the number of possible contracts for beef cattle being traded at any one time.[2] The anticipated profit or loss of a possible action, then, depends on the set of current prices and expected future prices for the various futures contracts, as well as on the costs of brokers' commissions.

Of course, the trader also has the option of utilizing his funds in some other unrelated venture.

The decision to buy or sell a futures contract generally is based on the speculator's knowledge of cash market conditions, since ultimately, in the delivery month, the futures price can be expected to bear some close association with the cash market price for commodities whose quality and market location are the same as those specified in the futures contract. If such a relationship fails to materialize, there will be inducement for traders either to make or take delivery of the live animals rather than cancel the contract with an offsetting action. Thus, since the current cash market

[2] Cattle futures contracts are deliverable every other month, and open interest frequently involves contracts calling for delivery a year and a half ahead of time.

conditions are more evident, trade in cattle contracts calling for delivery nearest to the current time period would be expected to have less risk, for example, than trade in contracts calling for delivery 6 months from now. In this sense, the expected profits from actions involving different futures contracts might be identical, but one action might involve higher variance (risk) than the other.

The relationship between the cash market and the futures prices is less than perfect. While the futures and cash markets generally are closely related in the delivery month, the two prices in most cases have not been equal. Furthermore, this difference between the futures price and the cash price at time of delivery has shown much variation historically, a factor which causes additional uncertainty for the trader who tries to apply his knowledge of the cash market to expected futures prices.

Analytical Framework

We shall assume that the speculator desires to take whatever action (buying, selling, or no action) will give him the largest expected profit, given some consideration of risk. To provide meaningful comparisons of alternative actions, we shall further assume that the speculator has a set amount of funds to invest. His actions will be limited, then, by the size of his funds and the commission and margin requirements for the futures trade.[3] Also, for simplicity, we shall limit the relevant time horizon to 6 months, giving the speculator an option of three futures contracts.

Putting the problem in the usual statistical decision framework, we can define P^f_{t+K} as the price at which a particular futures contract is eventually terminated (at time $t+K$). This price is also the state of nature (θ_h) about which the uncertainty exists, where "h" indicates a particular price or range of prices. The actions a_{ij} refer to buying or selling where $i = 1$ for sell and 2 for buy, and $j = 1$, 2, or 3 relating to the alternative contracts. The possible outcomes from actions a_{ij} and states of nature θ_h are given by λ_{ijh}, and are derived by the following:

$$\lambda_{ijh} = (-1)^i(P^f_{h,t+k} - P^f_t) - c$$

where c is the cost of the futures trade and all other terms are as defined above. The problem is shown in tabular form in table 1.

Given a marginal probability distribution of θ, $P(\theta)$, the problem as presented in table 1 could be solved as a "no data" problem by finding the expected payoff for each action. The objective would be simply to maximize the expected payoff of the various actions, where the expected payoff is given by

$$\text{E.P.}_{ij} = \sum_h \lambda_{ijh} P(\theta_h)$$

$$= \sum_h [(-1)^i(P^f_{h,t+k} - P^f_t) - c] P(\theta_h)$$

Such a formulation overlooks changes in supply and demand conditions. It seems more logical to base our actions on some experimental result, Z, or predictive tool—such as a price forecast—which would yield a conditional probability distribution of θ_h with less variance than that of the marginal distribution, $P(\theta)$. The optimum action, then, would be the one that maximizes

$$\text{E.P.}_{ij} = \sum_h [(-1)^i(P^f_{h,t+k} - P^f_t) - c] P(\theta_h|Z).$$

Because of the relationship of the futures price to the cash market at time of delivery, a recursive system of equations developed to predict monthly live cattle cash prices was used as an "experiment" to generate a conditional distribution for futures prices. The distribution of estimation errors, given predicted cash prices (derived from the regression results), was combined with a marginal probability distribution relating to the "basis," or amount by which the futures market price differed from the cash market price at time of contract termination. The resulting joint a posteriori distribution was used to estimate the expected value of each alternative action, a_{ij}.[4]

In this particular problem, the distribution of the predicted cash price varies as the length of the projection varies (1, 2, or 3 months, etc.), and as the month for which the projection is being made varies (first, second, or third month of a quarter). The variances of the distributions generally increase as the length of projection increases, a factor which is not included in the usual Bayesian framework. In order to consider possible

[3]Current cattle futures contracts traded on the Chicago Mercantile Exchange call for delivery of 40,000 pounds of Choice beef cattle. Margin requirements are $400 per contract, and the brokerage or commission fee is $36 per complete contract transaction.

[4]The mean of the sum of two variables, x and y, is given by $M_{x+y} = M_x + M_y$, and the variance by $\sigma^2_{x+y} = \sigma^2_x + \sigma^2_y + 2\sigma_x\sigma_y r_{xy}$, where r_{xy} is the correlation between x and y. These parameters then can be used to derive the resulting joint a posteriori distribution.

Table 1.—Representation of a decision problem for speculating on three futures contracts

States of nature (prices in the future)	Outcomes of various actions on contracts for—					
	February		April		July	
	A_{11} (sell)	A_{21} (buy)	A_{12} (sell)	A_{22} (buy)	A_{13} (sell)	A_{23} (buy)
θ_1	λ_{111}	λ_{211}	λ_{121}	λ_{221}	λ_{131}	λ_{231}
θ_2	λ_{112}	λ_{212}	λ_{122}	λ_{222}	λ_{132}	λ_{232}
θ_3	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
θ_H	λ_{11H}	λ_{21H}	λ_{12H}	λ_{22H}	λ_{13H}	λ_{23H}

aversion to risk on the part of the speculator, the usual decision-making framework was extended to reflect the certainty equivalence modifications suggested by Baumol (1).

Basically, Baumol's concept involves relating the degree of risk, or variation, to the expected return by subtracting a uniform multiple of the population standard deviation from the expected return of alternative actions. The resulting figures are returns for which the probabilities of being exceeded are identical regardless of differences in variances of the distributions involved, given normal distributions of returns for the various investments. Thus, the decision strategy is to select that action which gives the highest value of the function:[5]

$$W = E - k\sigma$$

where

E = expected or mean return
k = some constant
σ = standard deviation of the distribution of returns

If k equals 1, then about 84 percent of the time the return will reach level W or higher.

In applying Baumol's development to the speculation problem, we can define the decision function for buying as

$$W = (E - k\sigma') - P_t^f - c$$

where

$E = P_{t+k}^c + b$ (predicted cash price plus mean basis)
σ' = standard deviation of the sum of forecasting error and basis
c, k, and P_t^f are as defined earlier.

The formulation for selling would be

$$W = P_t^f - (E + k\sigma') - c$$

This development can be used as a first step in evaluating speculation alternatives. Those ventures which do not show a positive expected profit after consideration of the variance factor are deleted. Those remaining can be analyzed further in terms of the relative probabilities and magnitude of gains.

Results

Price-Forecasting Model

The set of cash prices is estimated recursively from a pyramid of predicted values of certain independent variables. The general procedure is to forecast the Chicago prices of 900- to 1,100-pound Choice slaughter steers as a function of (1) previous monthly prices (1 and 12 months previous), (2) predicted marketings of fed cattle in major feeding regions of the United States, and (3) shift or dummy variables. Fed-cattle marketings, in turn, are predicted on the basis of additional equations.

The structure of the price-forecasting model is outlined by the following set of equations:[6]

[5] This problem could also be formulated under the safety-first concept advanced by Roy (13), in which the probability of disaster is minimized, or under the safety-first principles offered by Telser (14), in which expected profit is maximized given some constraint on the probability of ruin.

[6] A detailed description of the price-forecasting model is given in (3); however, that study was based on El Centro, Calif., prices. The present study refers to Chicago prices and has been revised to include 1968 data.

Price-forecasting equation (P_{ji}):

$$P_{ji} = f_j(M_{ji}^k, P_{(ji)-1}, P_{(ji)-12}, Q_1, Q_2, Q_3)$$

Choice slaughter cattle prices (P_{ji}) are predicted as a function of projected marketings of fed cattle (M_{ji}^k) in various regions, lagged prices of Choice steers, and quarterly dummy variables.[7] The subscript $j = 1, 2,$ or 3 and refers to the month of the quarter for which the projection is being made; the subscript $i = 1, 2, 3 \ldots 6$ and refers to the length of the projection in months. Thus, P_{22} would indicate a 2-month prediction of the second month of a quarter.

Fed-cattle marketings (M_j^k):

$$M_j^k = g_j(W_h^k, Q_1, Q_2, Q_3, T)$$

Fed-cattle marketings (M_j^k) (j defined as above) in region k are projected as a function of either predicted or actual cattle on feed (W_h^k) by weight group h in the region, plus quarterly variables and linear time trend.[8]

Cattle on feed (W_h^k):

$$W_h^k = f_h(S_k, C_k, W_{1k}, W_{2k}, W_{3k})$$

The number of cattle on feed in weight group h for region k is a function of January 1 inventories of steers (S_k) and calves (C_k) and the number of cattle on feed by weight group (excluding $h = 4$) in region k in the current quarter, or the total for the most recent two quarters.[9]

The model revolves around estimates of cattle on feed from which predicted marketings of fed cattle are derived. Since cattle-on-feed data are available only for the first of each quarter, the model is segmented by quarters. Either the current number of cattle on feed, or a projection of cattle on feed at the beginning of a quarter, is needed to estimate marketings of fed cattle for the months in that particular quarter.

In some instances, projected cattle and calves on feed may require estimates of January 1 steer and calf inventories. The functional relationships used to predict these numbers are:

Steer inventory ($S_{(t+1)k}$):

$$S_{(t+1)k} = g_k(C_{tk}, BC_{(t-1)k}, M)$$

Steer inventory on January 1 for the coming year in region k is a function of the January 1 inventory for calves for the current year in that region (C_{tk}), the January 1 inventory of beef cows for the previous year in that region ($BC_{(t-1)k}$), and the average Kansas City-Chicago feeding margin for the current year up to the time of projection.[10]

Calf inventory ($C_{(t+1)k}$):

$$C_{(t+1)k} = h_k(PP'_{(t-1)}, BC_{tk}, BH_{tk}, PP')$$

Calf inventory on January 1 for the coming year in region k is a function of the average price of feeder steers at Kansas City the preceding year ($PP_{(t-1)}$), inventories of beef cows (BC_{tk}) and beef heifers (BH_{tk}) on January 1 of the current year in region k, and the average price of feeder steers at Kansas City for the current year up to time of projection (PP').

Ordinary least-squares regression techniques were used to estimate the parameters of the model with data for 1960 through 1968.

The estimated coefficients for the price-forecasting model are presented in table 2. Three equations are given for each of the six monthly situations. The equation to be used depends on the month in the quarter for which the prediction is being made and the length of the projection. Thus, predicting the price for August on March 1 would require a 6-month projection for the second month of a quarter, or equation (17).

The use of projections as regressors clearly violates a basic assumption of least squares—that the regressors are nonstochastic—and leads to biased and inconsistent estimates of the parameters (7, pp. 282-84; 11, pp. 331-34). However, despite the bias of the estimated coefficients, the least-squares prediction does yield a

[7] Quarterly dummy variables take on values of 1 for the quarter for which the projection is being made and zero for all others. Projections for the fourth quarter use − 1 values for all three dummy variables. In this manner the coefficients of the dummy variables are forced to sum to zero.

[8] Weight groups are 1 = 500-699 pounds, 2 = 700-899, 3 = 900-1,099, and 4 = 1,100 or more pounds. The cattle feeding regions used are as follows: California, Arizona, Texas, Colorado, and North Central Region.

[9] Separate equations are used for projecting cattle on feed, depending upon from which quarter the projection is being made; i.e., equations used if the projection is made January 1 are different from those used if the prediction is made on, say, July 1.

[10] The feeding margin is specified as being the difference between the current price of Choice slaughter steers at Chicago and the price of feeder steers (all weight and grades) at Kansas City 6 months previous.

Table 2.–Monthly forecasting equations for Chicago prices of 900 to 1,100-lb. Choice slaughter steers[a]

Equation	Length of price projection (months)	Month of Quarter	Constant	Lagged Prices		Projected marketings of fed cattle					Quarterly dummy variables			Standard error of estimate	R^2
				P_{t-1}	P_{t-12}	Calif.	Ariz.	Colo.	Texas	North Central	Q_1	Q2	Q_3		
1	1	1	25,5993	.8085	.0612	-.0296	.0373	.0560	-.0145	-.0212	.9752	-3.9476	.9255	.6575	.9003
				(.0636)	(.0813)	(.0141)	(.0680)	(.0328)	(.0117)	(.0126)	(.6886)	(1.6751)	(.7902)		
2	1	2	32.6199	.8138	.0949	-.0224	.0170	.1492	-.0121	-.0381	1.3568	-.5771	-.5711	.9307	.8178
				(.1096)	(.1373)	(.0203)	(.0556)	(.1052)	(.0290)	(.0238)	(1.2614)	(1.6448)	(.8133)		
3	1	3	14.1734	.9250	-.1086	-.0075	-.0119	.0735	.0110	-.0146	.1056	1.0965	.1730	.8422	.8772
				(.0944)	(.0893)	(.0157	(.0543)	(.0353)	(.0139)	(.0066)	(.4925)	(1.0193)	(.4667)		
4	2	1	17.3889	.8234	.1358	-.0513	.0555	.1040	-.0370	-.0152	2.0954	-4.3642	-.0039	.9391	.8029
				(.1010)	(.1149)	(.0200)	(.0977)	(.0464)	(.0169)	(.0186)	(1.0101)	(2.4035)	(1.1725)		
5	2	2	51.1228	.7174	.1943	-.0231	.0196	.2415	-.0204	-.0633	2.4014	-.0217	-1.3913	1.1610	.7165
				(.1393)	(.1682)	(.0253)	(.0695)	(.1275)	(.0361)	(.0285)	(1.5342)	(2.0433)	(.9768)		
6	2	3	12.6095	.8998	-.1017	-.0124	-.0324	.0792	-.0043	-.0100	.3929	.3508	.1425	1.3091	.7032
				(.1798)	(.1458)	(.0244)	(.0845)	(.0571)	(.0221)	(.0110)	(.7829)	(1.6284)	(.7257)		
7	3	1	10.1717	.8995	.1025	-.0529	.0076	.1192	-.0416	-.0078	2.2022	-3.3785	-.4593	1.1243	.7175
				(.1438)	(.1386)	(.0239)	(.1161)	(.0553)	(.0203)	(.0230)	(1.2202)	(2.9289)	(1.4433)		
8	3	2	59.4453	.6407	.2751	-.0207	.0174	.2960	-.0289	-.0756	2.9922	.2553	-1.8443	1.3351	.6340
				(.1669)	(.1914)	(.0291)	(.0800)	(.1447)	(.0414)	(.0325)	(1.7489)	(2.3513)	(1.1099)		
9	3	3	10.3537	.8885	-.0567	-.0066	-.0218	.0777	-.0060	-.0097	.3007	.3461	.2420	1.4877	.6167
				(.2396)	(.1677)	(.0281)	(.0959)	(.0681)	(.0255)	(.0132)	(.8944)	(1.8788)	(.8280)		
10	4	1	60.5648	.6130	.0667	.0433	.0606	.0274	.0505	-.0653	-1.0472	-.0751	3.1680	1.2668	6414
				(.1929)	(.1664)	(.0379)	(.1087)	(.0904)	(.0325)	(.0320)	(1.5962)	(1.6555)	(1.6113)		
11	4	2	4.3746	.8542	-.0547	-.0077	.0335	-.0502	.0165	.0032	-.9880	-1.2046	1.0349	1.4628	.5605
				(.1805)	(.1538)	(.0237)	(.1098)	(.0911)	(.0366)	(.0190)	(1.8750)	(3.8320)	(2.3070)		
12	4	3	3.6059	1.0892	-.2180	.0197	-.0891	-.0025	.0045	.0007	.8582	.3656	-.1774	1.5327	.5875
				(.2372)	(.1446)	(.0294)	(.1505)	(.0550)	(.0262)	(.0125)	(1.0876)	(3.2264)	(1.2522)		
13	5	1	-13.1291	1.1543	.0839	.0195	-.1465	-.0562	.0228	.0130	-1.4973	3.5276	-1.5205	1.1524	.6994
				(.2303)	(.1486)	(.0337)	(.1072)	(.0584)	(.0184)	(.0190)	(1.1273)	(1.7810)	(2.3656)		
14	5	2	-11.1833	.8938	-.0817	-.0104	-.0341	-.0684	-.0123	.0258	-2.0870	-5.5810	3.6527	1.4234	.5862
				(.1921)	(.1579)	(.0230)	(.1083)	(.0889)	(.0367)	(.0192)	(1.8500)	(3.8732)	(2.3196)		
15	5	3	9.0047	1.0126	-.2604	.0294	.0125	.0416	.0148	-.0127	.5202	3.2248	-.7612	1.6733	.5276
				(.2796)	(.1652)	(.0335)	(.1641)	(.0582)	(.0285)	(.0130)	(1.2042)	(3.5599)	(1.4431)		
16	6	1	19.7344	.7336	-.0690	-.0083	.0481	.0257	.0078	-.0142	.6056	-2.0390	1.5775	1.4887	.5202
				(.2829)	(.1861)	(.0467)	(.1413)	(.0700)	(.0271)	(.0230)	(1.5260)	(1.7941)	(2.9146)		
17	6	2	-9.6748	.9617	.0794	-.0123	.0442	-.0193	-.0124	.0112	-.6951	-2.8970	1.3123	1.4248	.6014
				(.2067)	(.1723)	(.0320)	(.1659)	(.0986)	(.0352)	(.0205)	(1.8297)	(3.6153)	(1.2798)		
18	6	3	10.1827	1.0970	-.1849	.0269	-.0679	.0448	.0222	-.0143	.9736	4.2338	-1.1534	1.6415	.5634
				(.2859)	(.1633)	(.0330)	(.1658)	(.0617)	(.0278)	(.0135)	(1.2141)	(3.6229)	(1.4378)		

[a]Numbers in parentheses below the coefficients are standard errors.

value which converges in probability to the conditional expectation of the dependent variable given the observed values of the predetermined variables.[11] As Johnston comments, "Thus, where this type of prediction is required, least squares is appropriate, even though it would not be used to obtain estimates of the structural parameters" (9, p. 164).

The usual statistical tests of significance for the coefficients (e.g., the *t*-test), however, are not valid when stochastic regressors are used. Therefore, substantive conclusions cannot be made about the magnitude or signs of the estimated coefficients.

In all likelihood, some of the variables could be omitted from particular equations (e.g., Arizona marketings or last year's price). These variables were retained in all equations, however, since it can be argued a priori that such variables logically could be expected to have some effect on price.

As can be seen from table 2, the R^2 values decrease as the span of prediction increases. Conversely, the standard error of the estimate increases with the length of prediction.[12] The standard error figures in table 2 compare with standard deviations of the basic price data of $1.78, $1.87, and $2.06 for the first, second, and third months of the quarter respectively for 1960-68. The distribution of the residuals was tested for normality by a chi-square test and the null hypothesis was not rejected.

The Decision Model

The results of the regression analysis served as the basis for generating the conditional or a posteriori distribution for the states of nature (termination prices for the futures contract). To incorporate into the model the difference between futures price and cash price, the closing futures price on the last day of trade for a futures contract (usually the 20th of the month) was related to the Chicago daily cash price for 900- to 1,100-pound Choice slaughter steers, as reported by the U.S. Department of Agriculture. Contracts not closed out by the last day of trade are subject to delivery; hence, it was felt that this comparison would be the most meaningful, since the two markets at this point are closely related.[13]

Data for the 29 closing dates from April 20, 1965, through June 20, 1969, yielded a mean excess of futures prices over cash prices of $0.22 per hundredweight, with a standard deviation of $0.55.[14] The hypothesis that the distribution of differences was normal was not rejected by a chi-square test. The distribution is widely dispersed as indicated by the size of the standard deviation relative to the mean. The available data were insufficient to permit meaningful tests of seasonal changes in the basis or the development of other conditional distributions. Such additional analyses, however, might yield distributions with smaller standard deviations relative to their means than the one utilized here.

As indicated earlier, the expected futures price is based on the predicted cash price plus the expected basis. The distribution, then, of the expected futures price is the sum of the two separate distributions, and the variance is the sum of the two variances (assuming no correlation between the two series). The variance of predicted price $V(\hat{P}^c_{t+k})$ is given by[15]

$$\sigma^2_{\hat{P}} = \sigma^2 X'_* (X'X)^{-1} X_*$$

where

σ^2 is the disturbance variance (derived from the standard error of the estimate),

X_* is the vector of new observations of the predetermined variables from which P^c_{t+k} is being predicted,

$(X'X)^{-1}$ is the inverse of the product of the matrix of predetermined variables used in the regression analysis and its transpose.

Thus, the variance of P^c_{t+k} increases as the values of the predetermined variables move further from their means.

In our case, however, a price prediction for one point in time may be viewed as a single random drawing from the conditional distribution of P^c_{t+k} given X_* in which case the variance of the forecast error is given by

$$\sigma^2_f = \sigma^2_{\hat{P}} + \sigma^2$$

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[11] See Johnston (9), pp. 162-64 for proof.

[12] Similar tendencies in the R^2 and standard error values were found by Hayenga and Hacklander (8) and Rohdy, Hoffman, and Madsen (12) in their monthly price forecasting models.

[13] Since July 1968, delivery has been permitted after the sixth calendar day of the month, thus giving overlapping trade and delivery of contracts. This factor tends to bring futures and cash prices into a more predictable relationship during the entire month rather than just on the last day. The last day, however, was selected as representative, since after the close of trade that day there is no option other than to take or make delivery.

[14] Futures prices are given in Chicago Mercantile Exchange Yearbook (5), published annually.

[15] For derivation of the variance of the predicted values, see Goldberger (7), pp. 168-70.

The latter function reflects that the error in forecasting a single drawing is "the sum of two uncorrelated errors: the error in estimating the expectation of the distribution from which the drawing comes and the deviation of the drawing from its expectation" (Goldberger (7, p. 170)).

The variance of the forecast, σ_f^2, was then added to the variance of the basis to derive the standard deviations for the various alternative predictions. To solve the decision problem, then, cash prices are predicted for the months for which futures contracts are being traded, and \$0.22 is added to this figure to get the expected futures price at time of termination. If the predicted futures price is greater than the current futures price for a particular contract, then a buy action (a_2) is indicated. Conversely, a lower predicted price points toward a sell action (a_1).

In mid-January 1969, as an illustration, cash prices were predicted by the forecasting model for February, April, and June 1969, and then adjusted to include the futures-cash basis. Since these forecasts were higher than the relevant futures prices prevailing near the middle of January, the latter prices were subtracted from the predicted values to obtain expected payoffs from the alternative actions. The predictions and expected and actual payoffs are given in table 3.[16] In all three instances, the forecasting model underestimated the actual prices that developed, and the actual payoff exceeded the expected value. Nonetheless, the action indicated by the decision model was correct. The underestimation of actual prices which moved beyond the range of the price data included in the regression analysis emphasizes the need to incorporate recent data continually in revising the coefficients of the forecasting equations.

The risk component, however, must be included in the speculation decision. The variances of the predicted cash prices, σ_p^2, given the set of predetermined variables for February, April and, June, were 1.9691, 2.2492, and 4.8782 respectively. When added to the disturbance variances (the standard error of the estimate squared), these values resulted in estimated variances of a single forecast, σ_f^2, of 3.3167, 3.8539, and 7.5727 for the 3 months. The standard deviations of predicted futures prices then were 1.9024 for February, 2.0387 for April, and 2.8063 for June.[17]

The probabilities of making a profit, given the predicted values and current futures prices, are given in table 4. Thus, April has the highest probability of profit (.688); June is about the same (.681). February is somewhat less favorable, although still more than 50-50 (.539).

Table 3.—Predicted prices and expected payoffs for 3 futures contracts, January 1969

(Dollars per hundredweight)

Month	Predicted cash price	Predicted futures price	Current futures price[a]	Expected payoff[b]	Actual payoff[c]
February .	28.02	28.24	28.05	0.19	1.87
April . . .	27.78	28.00	27.00	1.00	3.53
June . . .	27.71	27.93	26.60	1.33	8.50

[a]Prices at close of trade January 17, 1969.
[b]Before deduction of commission charge.
[c]Based on prices at close of final day of trade.

Table 4.—Standard error of the forecast and probability of making a profit

Month	Standard error of predicted futures price[a] σ_{f*}	Probability of a profit[b]	Required price level[c]
	Dol./cwt.		*Dol./cwt.*
February	1.9024	.539	26.96
April	2.0387	.688	26.62
June	2.8063	.681	26.04

[a]Joint error for cash prediction and futures-cash differential.
[b]Converted to a standard normal by $(\hat{P}^f_{(t+k)} - P^f_t)/S_{\hat{P}^f} = Z$ where Z = standard normal variate.
[c]Based on requirement of probability of .75 of making a profit $\hat{P}^f_{(t+k)} - .6748\sigma_{f*}$.

If the speculator desires, say, a .75 probability of making a profit, he can evaluate the three buy alternatives by subtracting .6748 times the standard deviation of the futures price estimate from the expected value and comparing the resulting figure with the current futures price. The results of this procedure are shown in the last column of table 4. On this basis, no action would be taken since current prices of all three contracts are above the level needed to give a .75 probability of profit.

Either procedure can be used to evaluate the speculation alternatives.

[16]Costs of futures trading have not been subtracted in this example; hence the profit figures are gross rather than net levels.

[17]These standard deviations are calculated as $\sqrt{\sigma_f^2 + (.55)^2}$ where $(.55)^2$ is the variance of the basis.

Summary and Conclusions

The above development illustrates an application of statistical decision theory to speculation in live beef cattle futures contracts. Cash prices are forecast by equations derived from statistical analysis, and then are adjusted to predict futures prices up to 6 months ahead. The variance of the forecast, derived from the least-squares regression analysis involving cash prices, is combined with the variance of the historical distribution of the futures-cash price differential to obtain a measure of the distribution around the predicted futures price. The resulting joint standard error is used to evaluate the probability of profit, given the predicted futures price and the current price for that futures contract.

If the speculator requires a particular probability of making a profit, he can apply the Baumol formulation by substracting some multiple of the standard error from the price forecast and comparing the remainder with the current futures price. Or, he can simply determine the probability of making a profit for each alternative and evaluate them accordingly.[18]

Any price-forecasting model, such as the one developed here, which is used for decision-making should be continually updated. This need has been particularly evident in projecting cash prices for live beef cattle where an upward trend in demand has pushed prices beyond the range included in the initial analysis. Although the price-forecasting model indicated the correct actions on the part of speculators for the first 6 months of 1969, it substantially underestimated prices for April and June.

[18]The speculator's subjective probabilities about price movements undoubtedly are important components of his decision process. He could inject his subjective probabilities into this model by computing $P(Z|\theta)$ as outlined in (4) and then apply his subjective estimate of $P(\theta)$.

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Hedging on the Live Cattle Futures Contract

By Russell Gum and John Wildermuth

Feeders who wish to hedge should consider more than the price for which they sell a fed cattle futures contract. They should also consider the efficiency of the hedge and the expected effective price which results from hedging. This is shown by selected comparisons of results for fed cattle marketed in Chicago, Phoenix, and Denver, May 1965 through December 1968.

Key words: Hedging, futures trading, cattle prices.

Hedging on the futures market has been used by many cattle feeders as protection against adverse changes in the price of fat cattle occurring within the feeding period. However, the results of a hedging operation, i.e., the amount of reduction in price uncertainty and the actual net price received for the hedged cattle, vary considerably depending upon the case in question. The results of a hedging operation are strongly influenced by the location of the feeder. Since at a point in time the price of the spot cattle futures contract is based primarily upon the Chicago cash market, regional differences in the level and seasonality of cattle production often lead to situations where the actual net price received by a feeder for hedged cattle differs considerably from the price for which he sold the futures contract. In addition, where delivery against the contract is not economically feasible, the relationship between the price for which the futures contract is sold and the net price received on a hedged contract may change over time.

The purpose of this paper is to investigate the relationship between the results of a feeder hedging on the live cattle contract and the location of the feeder. The investigation is a partial analysis, in that it explores only the relationships between spot and futures market prices for fed cattle. The prices of inputs are not considered. Specifically, this paper is concerned with developing estimates of the change in fed cattle price variability, hereafter referred to as "the efficiency of the hedge," and monthly estimates of the closeout basis[1] for three markets–Chicago, Denver, and Phoenix. The latter estimates are used to calculate the realized price, hereafter referred to as the "effective hedged price."

The Denver and Phoenix markets were chosen for this analysis because feeders marketing their live cattle based on prices in these markets find that it is by and large economically infeasible to make delivery against a Chicago futures contract. Consequently, the uncertainty relating to a hedging operation is particularly pronounced in these cases. The Chicago market is included for comparative purposes.

The first step in the analysis is the formulation of a theoretical model of the hedging operation. The theoretical model designed to provide estimates of the effective hedged price is then used as the basis for an empirical analysis of the actual relationships existing in the Chicago, Phoenix, and Denver markets from May 1965 through December 1968.

The Effective Hedged Price

A hedge against product price changes involves the cattle feeder making offsetting transactions in the live cattle cash and futures market. Thus, the price results of a hedge can be expressed as:

$$EP = FS + B - TC \tag{1}$$

where

EP = effective hedged price
FS = price for which contract is sold
B = closeout basis (this is the price for which cattle are sold minus the price for which the contract is bought back)
TC = transaction cost of hedging

[1] Closeout basis refers to the difference between the price for which a feeder sells his fat cattle and the price at which he buys back the futures contract.

The above equation defines the effective hedged price.[2] The efficiency of a hedge depends directly upon a comparison of the variability of the effective hedged price with the variability of the cash price and is best defined in relation to the concept of an ideal hedge.

An Ideal Hedge

An ideal hedge may also be defined in terms of equation (1). Given the above definition of the effective hedged price, an ideal hedge can be defined as a hedge under which the effective price received by the feeder for his fat cattle is exactly equal to the net sales price of the futures contract (sales price of the futures contract minus the transaction cost). The significance of an ideal hedge is directly related to the reduction of variability in the effective price. From the definition of the effective price (equation 1), it is obvious that under the conditions of an ideal hedge, the price variability is zero, since at the time the hedge is placed, the only unknown is the basis. Under the ideal hedge, the closeout basis equals zero and, therefore, introduces no uncertainty into the effective price.

A Realistic Example

Very seldom does the theoretical norm appear as an economic reality, and the operation of hedging is no exception. The ideal hedge is seldom achieved because of the factors of time, location, weight, and quality. The earlier the sale of the fat cattle before the closing date for the futures contract, and the further the cattle feeder is from the delivery point, the more the uncertainty about the basis.

An obvious feature of a nonideal hedge is that the effective price the feeder receives for his cattle does not equal the net sales price of the futures contract, but instead equals the net sales price of the futures contract plus the closeout basis. In addition, if the closeout basis has as a component random or unpredictable elements, a second feature of a nonideal hedge is a degree of risk in the effective price equal to the variability in the basis. The output price risk is equal to the variability of the closeout basis since all other components of the effective price are known to the feeder at the time he places the hedge.

The rest of this research is concerned with investigating the nature of this basis for the Chicago, Denver, and Phoenix fat cattle markets.

The hypothesis to be tested is:

Ho: The level, seasonal pattern, and variability of the closeout basis in the cattle futures market differs among areas.

To test this hypothesis, a multiple linear regression technique using a dummy variable for each month was employed.[3] The following specific model was fitted to weekly data from each area:

$$B = bj + e$$

where

B = closeout basis
bj = estimate of closeout basis for month j
e = random term

Thus, the expected effective price for a hedged contract in a cattle feeding area is equal to the net sales price of the futures contract plus the monthly estimate of the closeout basis bj. Note that this is only an expected effective price, for the closeout basis is influenced by a random effect as well as the expected monthly pattern. A comparison of the variance of the random component of the basis provides a measure of the efficiency of the hedge. This comparison is presented in terms of a ratio of the variances, which may be used directly to test for the reduction in variability by application of an F-test. For this comparison, seasonal influence in the cash market was removed by fitting a regression model of the same form as the model used to estimate the basis, i.e., dummy variables for each month were used as the independent variables.

The data used in this study are prices of 900-1,100-pound Choice steers as reported by USDA's Consumer and Marketing Service for the three markets studied, and the Chicago Mercantile Exchange weekly closing prices for the live cattle contract with the nearest closing date. For example, the closeout basis for the Denver market during the second week in May would be calculated as the Denver cash market price for

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[2]This applies to a commodity which is not storable. For the corresponding definition of effective hedged price for storable commodities, see Jerome L. Stein. "The Simultaneous Determination of Spot and Future Prices." Amer. Econ. Rev., Vol. 51, pp. 1012-25, Dec. 1965.

[3]For a discussion of "dummy variable" regression, see Arthur S. Goldberger. Econometric Theory. John Wiley and Sons, Inc., New York, 1964.

900-1,100-pound Choice steers minus the closing price of the June futures contract for the second Friday in May. The data used in the analysis apply to the period May 1965 through December 1968 (192 weeks).

Results

Expected Effective Price

The adjustments, which must be added to the price for which a feeder sells a futures contract to determine the expected effective price (the closeout basis), are presented in table 1.

As was expected, the general magnitude of these adjustments was greater for Arizona and Colorado feeders than for Illinois feeders. An *F*-test was performed to test whether all of the coefficients for each regression were equal to zero. This hypothesis was accepted for the Illinois hedge and rejected for the Arizona and Colorado hedge at the 1 percent confidence level.

Table 1.—Estimates of the monthly closeout basis for the Chicago, Denver, and Phoenix live cattle markets

Item	Region		
	Chicago	Denver	Phoenix
Month:			
January	0.065	- 0.957	- 0.718
February	- 0.024	[a]- 1.537	- 0.585
March	[a].345	[a]- 1.645	[a]- .139
April	- .039	[a]- 1.546	[a]- .217
May	- .059	- 1.138	[a]- .425
June	- .416	- .767	[a].192
July	- .498	[a]- .489	[a]- .156
August	- .345	[a]- .551	- .784
September	- .163	[a]- .582	- .947
October	.028	- 1.117	- 1.649
November	[a].384	- .933	[a]- 1.450
December	- .218	- .930	- .941
Mean of basis	- .097	- .976	- .670
R squared	.135	.298	.376
F statistic	2.558	[b]6.938	[b]9.855
Standard error	.690	.584	.715
Standard deviation of cash price	1.224	1.105	1.251
Efficiency of the hedge (ratio of variances)	[c]3.147	[c]3.580	[c]3.061
Number of observations	192	192	192

[a]Significantly different from the December estimate at the 95 percent level.

[b]The hypothesis that all regression coefficients equal zero was rejected at the 99 percent level.

[c]The variances were significantly different at the 95 percent level.

Therefore, the expected effective price for an Illinois feeder is the price for which he sells the futures contract. For an Arizona or Colorado feeder, the expected effective price is the price for which he sells the futures contract plus or minus the estimated adjustment. For example, if an Arizona feeder sells a contract for $27 a hundredweight for cattle which will be ready to sell in November, the expected effective price is $25.55 per hundredweight (27 – 1.45).

The seasonal pattern of the basis is different for the Phoenix and Denver markets. The data analyzed indicate that the most favorable closeout basis for Colorado feeders occurs in the last half of the year, while for Arizona feeders the most favorable period is in the first half of the year (see table 1).

Efficiency of the Hedge

The reduction in price variability was of a similar order of magnitude for all markets. The ratio of the price variance in the cash market to the price variance for hedged cattle ranged from 3.06 to 3.58. The hypothesis that hedging reduces price variability of cattle feeding was accepted for all markets at the 1 percent confidence level (see table 1).

Conclusion

Feeders who are considering use of the Chicago live cattle futures contract as a means of reducing product price risks, must consider more than just the price for which they sell a futures contract. They must, as pointed out by the Phoenix example, consider both the efficiency of the hedge and the expected effective price which results from hedging. While the estimates presented in this article may not be directly applicable to any given feeder's decision process, nevertheless, the model and results are offered as usable in their present form.

Ideally, of course, the feeder's decision model would also include expectations relating to price trends in the product and input cash market. When expectations of product cash prices and input costs are included in a feeder's decision model, a choice can be made between the expected profit of hedged cattle versus the expected profit associated with utilizing the cash market, and the associated price risks. It is suggested that further research to provide a theoretical and empirical basis for the integration of the hedging decision into the feeder's total decision-making process would prove fruitful.

Procedure for Including a Timber Enterprise in a Programming Evaluation of River Basin Development

By Richard Greenhalgh and Karl H. Davidson

Wood products are included as competing enterprises in a model used as an aid in evaluating the need for land and water resource development. The procedure for developing linear programming data inputs for veneer, sawtimber, cordwood, and "other" enterprises is presented. Detailed land use was developed from secondary sources. Data for enterprise budgets were developed mainly from experience on publicly owned land. The river basins examined were found to be capable of meeting food and fiber needs for the next 50 years, although improved woodland management is necessary. An increase in woodland acreage is needed to meet wood product demands after 1980.

Key words: Enterprise budgets, linear programming, resource development, resource use, river basin planning, timber resource planning, woodland clearing.

All areas of our Nation have been scheduled to undergo a comprehensive investigation of their land and water resources. Some areas have been, and others will be, investigated more than once under various types of river basin studies. Such studies usually involve a detailed analysis of the land resource's capability to meet the projected demand for nonwood products, but few have placed more than minor emphasis on wood products.

Woodland is a major land use in the two river basins we investigated, and we wanted to know some of the possible effects that resource development would have on timber production in the basins. Since we were using linear programming to analyze possible economic effects of resource development on crop production, we decided to include forest production activities in the same model. In this paper we discuss (1) some of the problems of including wood products in the evaluation, (2) our approach to wood products as a crop competing with other crops for the available land resource, and (3) some preliminary findings. We are not providing numeric estimates of other inputs or outputs of the model because we feel they are not germane to this discussion of procedure. Though input needs are specific, we feel that the results should be viewed as indicating direction rather than absolute outcomes.

Comprehensive Timber Resource Planning

Timber as a natural resource has both stock and flow resource properties (4).[1] The forest's growing stock provides an annual flow and a reservoir of timber which can be harvested, maintained, or expanded. Within given climatic zones the timber reservoir can be moved from one place to another, that is, from bottomland to upland or vice versa, or from drainage area A to drainage area B. However, a considerable period of time is involved in such a movement.

National timber supplies have been projected, but little effort has been devoted to planning ways of increasing national production beyond that which will occur naturally through the actions of thousands of independent land managers. This is partly because annual forest growth in this country has exceeded annual cut over the past 30 years. Such a situation is not expected to continue. The total volume of growing stock is increasing, but so is the total demand for wood products. Also, some specialty woods are becoming scarce. A report by the Forest Service projects sawtimber cut to exceed growth in the Southern States by

[1] Underscored numbers in parentheses indicate items in the References, p. 111.

1990 (5). If this happens, some segments of the timber industry could be completely disrupted.

Some land and water resource development projects affect the timber resource. Flood protection and drainage projects often result in a change in land use, including clearing, and may reduce the long-run supply of timber products. Clearing of woodland capable of producing sawtimber and veneer, and putting the land in crops, may be imprudent, considering that (1) agricultural crops are in surplus, (2) sawtimber and veneer woods may become scarce, (3) cost-reducing technology for making wood substitutes is uncertain, and (4) several decades are required to produce trees for sawtimber and veneer.

Land use planning, including comprehensive river basin planning, should integrate the planning for various major land uses. Investigation of current and future production capabilities of the timber resource needs to be undertaken in conjunction with the other productive uses of farmland. The importance of such an investigation becomes apparent when it is realized that decisions made in the forest industry today may influence the supply of timber as much as 50 years hence.

This report is only concerned with appraising the economic contribution of the forest toward meeting expected future food and fiber needs. Such information would be helpful in formulating long-run policies of timber-management—both public and private—as well as in establishing type, scale, location, and priorities for planning natural resource development needs.

The Programming Model

Land use shifts and resource development are dynamic processes. Linear programming is often used as a tool of comparative statics to help establish optimum land use and evaluate resource development needs. Such a tool was used in this analysis for future years—1980, 2000, and 2020. The basic inputs are production requirements, land resources, production costs, yields, current land use, and constraints on shifts in land use.

The future levels of basic inputs were estimated aside from the model. The object of the analysis was to estimate least cost patterns of land use to achieve the production requirements established for the basin under various assumptions, including levels of resource development.

The production requirements were estimates of the future quantity demanded from the basin at existing price levels. They merely served as planning goals. The land resource was classified into soil productivity groups based upon resource problems and production potential. Production costs included only on-farm costs. Group-action project costs were not included. Yields were expressed on an annual per acre basis. Current land use and constraints on shifts in land use were used in developing future land use by restricting the shifts in land use implied by production cost differentials alone.

The general model was not originally devised to include forestry as a competing enterprise. Several basic differences between the production of timber and conventional crops present problems in identifying the inputs for wood products. Characteristics of timber production which present problems are (1) the relatively long production cycle of wood products—10 to 50 years, and (2) the fact that various products such as veneer, sawtimber, cordwood, poles, posts, and firewood may come from the same acre of woodland.

Detailed Land Use

In estimating the detailed use of woodland, a specific acre could not be considered as producing a single product. In this study, four product groups were established to represent the numerous products that could be obtained—veneer, sawtimber, cordwood (including pulpwood and fuelwood), and "other." A priority rating based on the length of the growth cycle for the product group was established. This rating also corresponded to the economic value of the groups. First priority was given to veneer, which has the highest per unit value and can only come from superior logs. Sawn lumber, which has the second highest per unit value and can come from veneer or sawtimber logs, was ranked second. Pulpwood has a per unit value less than veneer or sawtimber and can come from veneer logs, sawtimber, or pulpwood. It was ranked third. All of the remaining products, including wood chips, charcoal, and posts, were grouped into the last product group. These products could be made from poor quality timber not in the other three groups as well as from timber in these groups. Per unit value of these products varied by product but was generally lower than veneer, sawtimber, or pulpwood.

A composite woodland cropping pattern was developed by establishing the maximum percentage of timber growth that could be harvested for each wood product, in order of its priority rating. For example, a composite acre might have 10 percent of all growth available for veneer; half of the remainder, or 45 percent of the total, available for sawtimber; three-fourths of the residual available for cordwood; and the portion left available for "other" products (fig. 1). This relationship of products is referred to as the product mix.

PRODUCT MIX OF A TYPICAL COMPOSITE ACRE

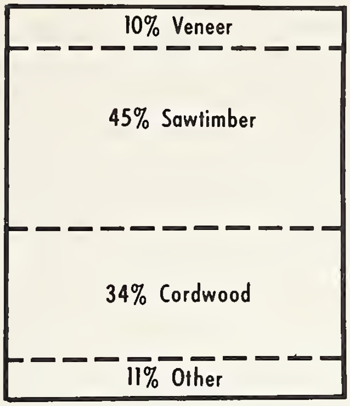

Figure 1

Woodland characteristics for each soil resource group were based on an analysis of the individual soils and forest type represented. The current capacity to support growing stock, growth rates, and the product mix assigned to each soil resource group was based on studies of site index and woodland growth, and on data collected from production of wood products on various forest types (2).

Through better management and the application of known technologies, the existing situation on a plot of land could be improved. The potential for a desirable change in the characteristics was examined by soil resource group for each projection period—1980, 2000, and 2020. The maximum possible change in annual growth and product mix, assuming 100 percent effectiveness of all practices, was developed. Since these practices would not be expected to be 100 percent effective, a 70 percent effectiveness level was arbitrarily assumed.

The mix of wood products varied by resource groups and future time periods. However, the bottomland sites represented a relatively high proportion of veneer hardwoods and sawtimber. Poor upland sites, where quality hardwoods could not grow, had a high proportion in pulp and "other" wood. Sites in between were assigned pro rata shares, based on soil productivity and known adaptability of forest types.

Clearing was evaluated by providing a transfer activity from unharvested woodland to other crop uses. Based on the assumed excess of growth over cut, future yields were developed for all periods under consideration before any runs were initiated. Later, it was realized that this should be a step by step process, and yields should be developed for the next time frame after the feasible clearing was established. Then, the clearing of unharvested woodland could influence yield projections for future periods.

Enterprise Budgets

Adequate secondary information was not available for production costs and yields of woodland on privately owned lands, where the major part of production occurs, and funds were not available to collect such data. Therefore, many of the basic data were derived from experience gained by Federal managers and supervisors. Studies conducted by industry, universities, and the Southern Forest Experiment Stations were also utilized (1, 3, 6). The available data imply a somewhat higher level of management and technology than would be likely to exist under private ownership. The possible bias toward public woodland was recognized but no adjustment was made in developing the enterprise budgets.

The budgets include those costs which can be associated with woodland enterprises including machinery and equipment depreciation, labor, and interest on capital for operating expenses. Overhead costs, such as interest on investment in land, building maintenance, motor vehicle expenses, insurance, and real estate taxes, are not included.

The exclusion of these overhead costs is one reason the production cost indicated in computer solutions cannot be viewed as the total farm production cost. However, the solutions can be utilized to make comparisons of costs with and without resource development. Although some of these overhead costs might increase with resource development, yields will also increase and the overhead cost per unit of product would be practically unchanged. Furthermore, these overhead costs are a small cost item in relation to total production cost.

Production costs were broken down into three components—annual maintenance costs, per unit preharvest costs, and harvest costs. Annual maintenance costs included such items as fire protection and disease and insect control, and these costs were a constant charge for all acres within a soil resource group. The cost of maintaining the unharvested woodland was allocated proportionately to the product groups harvested. Costs attributable to a specific product were established and classified as harvest or preharvest costs. These costs were aggregated by product group and converted to per acre costs, representing the cost of producing the equivalent of one acre's growth in the form of one of the four products. These budgets were developed for each product in each soil resource group. Such per acre costs do

not reflect composite acre costs or costs of actual harvest. For example, per acre costs of producing veneer in a soil resource group with a composite acre reflecting 10 percent veneer could be viewed as having three components: (1) Annual maintenance costs of 1 acre of woodland, (2) annual preharvest costs associated with veneer production on 10 acres of woodland, and (3) annual costs of harvesting a quantity of veneer equal to 1 acre's total growth from 10 acres of woodland.

In developing projected yield, a given level of management and technology is implicitly assumed. In the two basins studied, forest composition with respect to tree size and number does not presently provide for maximum increase in the volume of growing stock. The management level assumed included the maintenance of timber growth in excess of cut. This allowed a shift toward improved forest composition and yields over time, obviously at the expense of current production.

The proportion of woodland acreage reflecting the excess of growth over cut was maintained as unharvested woodland. In a situation where demand could not be met, the assumed level of growth over cut could be reduced but this would affect future yield projections. If cut and growth were assumed to be equal, only minor yield increase could be anticipated. When cut in excess of growth is necessary to meet demands, yields would remain constant and the woodland resource base would be reduced for future time periods.

Yields which reflect per acre total growth were used for each wood product. The calculated yield by soil resource group was based on the selected management level and two specific assumptions relating to management. One assumption was that timber would be harvested for the highest priority product possible, if needed. That is, a tree suitable for veneer or sawtimber would be cut for pulpwood only if it were not required for the higher priority products. Demands in the lower priority groups could be satisfied by cutting trees in the higher priority groups. The other assumption was that the volume of growing stock would increase through better management practices.

Changes in Woodland Use and Production

The constraints placed on woodland use in the two basins varied by product group and soil resource group. The composite acre represents maximum use of the resource for veneer and sawtimber. For example, the product shares of 10 percent veneer and 45 percent sawtimber illustrated in figure 1 present maximum per acre production in a particular time period, and are structured into the model as upper acreage limits. In the event that veneer and/or sawtimber demands cannot be met, additional woodland acreage would be required. However, such a situation prescribes that trees must be planted some 20 to 50 years before the timber is needed.

The part of a composite acre established for cordwood and "other" wood represented the portion of growth which was not of a size or species suitable for veneer or sawtimber. Actually, the major part of total growth could be harvested for cordwood and "other" wood. Therefore, 34 percent cordwood and 11 percent "other," as reflected in figure 1, were established as lower limits, and the upper limits were left open. This allowed for some of the sawtimber and veneer acreage to be used for cordwood or "other" products if they were not needed for the higher priority uses.

Minimum levels of production of wood products were established for the basins by allocating a share from preliminary projections for the lower Mississippi Water Resource Region. This allocation was on a land area percentage basis. An allocation based upon present production would have been more desirable but the necessary data were not available. The projections were based on a percentage allocation of the national projections for wood products (7). They could be interpreted as the necessary increase in production of wood products so that this area could maintain its relative share of expected national wood product production.

Concluding Remarks

Several land resource use solutions were analyzed. Woodland clearing and flood protection were both considered. In the two basins studied, the land resource was found to be sufficient to produce its share of national demand for food and fiber, including wood products. The present woodland acreage base is sufficient to meet future veneer, sawtimber, and "other" wood product demand. However, to meet expected pulpwood demand, additional acres of woodland would be needed. In these basins the additional resource base needs to be established immediately for expected future production.

The provision of flood protection was found to affect timber resource use in two ways: (1) The location and scale of feasible clearing varied between solutions with and without flood protection, and (2) the location of the additional woodland needed varied with and without flood protection. This was because the better land was needed to meet the pulpwood demands without development. However, with development the stress on the land resource was diminished and the pulpwood was shifted to less productive acres.

Model adaptation, as discussed, is not the only problem in including wood products with crops in the evaluation. There are several areas where more basic information is needed. Budgets were developed mainly from experiences and costs on publicly owned land. More information is needed to determine the acceptance rates for new technology that can be expected from the private sector. Little is known about the actual effects of various development activities on the production of wood products. For example, beneficial or detrimental effects of flood protection were not included in the wood product budgets because of the lack of research in this area.

Future demand for wood products is an important factor in this analysis. Additional research in this area would be helpful.

A 50-year growing cycle for some wood products, e.g., veneer, means that we estimate now the harvest needs for 50 years hence, and dedicate some land to their production. Our experiences indicate that such harvest needs can be evaluated by including wood products as well as crops in the conventional linear programming models. We feel this is a step in the right direction and hope that we have generated enough interest for this approach to be further investigated.

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Book Reviews

Economics as a Science

By Kenneth E. Boulding. McGraw-Hill, New York. 157 pages. 1970. $6.95 paperback.

The seven chapters of this book, though related, are written as indcpendent essays. The first six chapters consider economics respectively as a social science, an ecological science, a behavorial science, a political science, a mathematical science, and a moral science. The final chapter considers economics and the future of man. The book is not intended as a textbook, but rather as a treatise to enrich cconomists' appreciation of the "larger scientific background" of their discipline. Boulding appears to consider this task to be even more important than the acquisition of specific analytical techniques.

There is little new in this book with respect to economics, per se, but there are some new interpretations of economics as it relates to the other disciplines mentioned. With respect to economics as a social science, the author suggests the major contributions of economics to the total study of society lie first in its concept of what might be called "the generalized price structure," that is, the total structure of all terms of trade—a structure which is of enormous importance in determining dynamics of performance in the total social system. The second important contribution is in the field of decision theory, where economics helps determine the performance reaction to perceived changes in the environment of the actor.

The chapter on ecology is particularly appropriate to today's interest in the economics and biological disciplines and Boulding uses the currently popular "ecosystem" as his working model. One interesting concept he utilizes pertains to the principal difference between biological populations and populations of commodities: He points out that, whereas the major limiting factor in the case of biological populations tends to be the death rate, in the case of commodities it tends to be the birth rate. Perhaps we are only now recognizing this phenomenon in an operational way. Boulding recognizes the population explosion and its implications and discusses the "spaceship earth" concept. This is the thesis that our ecosystem will soon require us to recycle all of the resources that we use if the environment is to remain in equilibrium and not destroy itself.

Boulding contends that the welfare of a society should be measured strictly by its state or condition and not by its throughput of production and consumption, for the gross national product increasingly includes such unproductive and mainly "maintenance" items as national defensc, commuting to work, the replacement of unnecessarily shoddy commodities, etc. It is Boulding's contention that the ideological conflict between socialism and capitalism is no longer a controversy between advocates of planning and those of laissez-faire, rather it is a controversy over the best methods of deciding what future the society wants and how it proceeds to obtain it.

In discussing economics as a behavorial sciencc, Boulding discounts the usefulness of traditional marginal analysis for decision making, primarily because data on which decisions would have to be based are often unavailable. He attributes more merit to cost-benefit analysis and program budgeting. At several junctures he makes the strong point that there is a common tendency among economists to mistake abstractions for reality and to assume decision making can be based entirely on these abstractions. Introduction of politics into decision-making makes the "Pareto better off" concept largely irrelevant to many important problems. This is particularly true of those problems dealing with public goods as compared with private goods.

Mathematical science according to Boulding has made a very substantial contribution, but he reminds us that mathematics in any of its applied fields is a wonderful servant but a very bad master. In social systems, and in economic systems in particular, a real shortcoming of econometric analysis has been that of unexpected changes in the parameters, the basic constants of the equations.

In discussing economics as a moral science, Boulding points out that the scientific subculture is itself characterized by a strong common value system. High values are placed on veracity, curiosity, measurement, quantification, observation, experiment, and objectivity. Moreover, as science develops, it no longer merely investigates the world but creates the world which it investigates. Boulding lists three areas in which economics has made a contribution to general ethical theory. The first is a generalization of the theory of exchange value in the direction of ethical and social choice. The second is the field of welfare economics, and the third, the impact of

economic measurement and indices upon normative judgments, especially in political life.

Boulding cites major contributions of economics to man in two fields. One is that of macroeconomics and employment policy, which has eliminated the extreme fluctuations exemplified by the depression of the 1930's. The second contribution is proficiency in the area of decision making which has been enhanced by programming and related economic analyses. The major failures of economics are cited as inability to develop an adequate theory of economic development to serve as a basis for policy recommendations for the poor countries, failure in the field of urban poverty, and deterioration in the whole matter of providing improvements in the physical environment. Boulding's reasons for these successes and failures are themselves very interesting.

In conclusion, Boulding points out that recently trained economists have not been exposed to the "great empiricists and institutionalists of the past." Granting the value of econometrics, he regrets that the quick return to economics in the last 30 years has been through bright young mathematically inclined economists who have devoted themselves to the analysis of existing data rather than to the collection of new data at the source. He also adds a critical comment or two relative to the contribution of graduate schools in fostering this situation.

This set of essays, like most of Boulding's writings, is extremely interesting and thought provoking. Few people will agree with everything he says, but I would expect that few people would read the book without indulging in some good intellectual stocktaking of where the economics profession is and where it should be heading. As usual, Boulding includes some good humor and criticism. He does a convincing job of questioning the legitimacy and relevancy of moving in a one-to-one relation from a value theory based on utilitarianism to a market-based economics.

W. B. Sundquist

Economic Analysis and Operations Research: Optimization Techniques in Quantitative Economic Models

By Jati Sengupta and Karl Fox. North-Holland Publishing Company, Amsterdam and London, and American Elsevier Publishing Company, New York. 478 pages. 1969. $20.10.

Economists tend to weave a unified theory around problems. This gives a sense of interconnectedness among problems; a unity of approach among researchers; and a source of testable hypotheses with which to initiate research. Operations researchers are more Baconian in their philosophical approach: They pragmatically seek to induce empirical answers to immediate problems. Sengupta and Fox have presented us with a publication whose title, "Economic Analysis and Operations Research," suggests a merging of the two disciplines. But the fundamental difference in methodological approach is wide enough to preclude merger. The organization and content of the book does not benefit so much from the authors' understanding of economics as from their understanding of operations research techniques. Consequently, the reader can learn a lot about techniques but not much about economics. The intersection of the two disciplines displays a common interest in the types of problems tackled and in the mathematical and statistical techniques used. The authors' awareness of this is acknowledged by their subtitle: "Optimization Techniques in Quantitative Economic Models." This subtitle is descriptive of the book's content: A selected collection of mathematical and statistical techniques of interest to workers in both disciplines.

Half the book is devoted to programming techniques. The unique strength of this section lies with the authors' ability to buzz through dozens of variations in the activity analysis problem, devoting to each a page or two for a precise mathematical statement of the variant problem and a page or two on computational aspects. Occasionally a page or two is allocated to an application. This section opens with a 12-page statement of the conventional linear programming problem which is tightly written and covers as much ground as is often covered in an entire book. Its function here is mostly for review and for establishing notation. Prospective readers are advised to know what is in these 12 pages as a prerequisite to picking up the book in the first place. The next 200 or so pages give fascinating peeks into all sorts of variations on the programming problem including fractional, integer, decomposition, recursive, quadratic, variational, control, dynamic, parametric, sensitivity, probabilistic, risk, and other programming.

The rest of the book is independent of the programming section. It treats of calculus, matrix algebra, and probability techniques used in the theory of the firm and microeconomic equilibrium, macroeconomic topics, and regional analysis. As with the programming section, the authors do not duplicate the ordinary textbook treatment of these topics. Rather, they assume that as a prerequisite and proceed to wander through many variations of the usual problem formulation. They look into problem formulations of inventory control, investment in plant and equipment, intertemporal firm and industry equilibrium in perfect and imperfect competition, growth, location of firms and of economic activity, decentralization, optimization for a nonmarket institu-

tion, and nonmarket aspects of complex social systems.

Your reviewer enjoyed reading this book, and he learned something about optimization techniques in the process. Now he is anxious to recommend the book. The problem is: To whom? It is hard to recommend to students because the prerequisites are demanding and the topical coverage is selective. It is hard to recommend as an encyclopedic reference volume because the many formulations are scattered, with poor indexing and cross referencing and with few guiding subtitles. It is hard to recommend to browsers because it is tightly written and the notation flows with subtle changes from one problem to the next, making it difficult to find an intermediate starting point from which to browse. However, many readers go through books such as this one seeking inspiration to formulate variations of their own in order to tackle immediate problems of their own requiring application of advanced optimization techniques in quantitative economic models. If you are one of those readers, I recommend this book to you as a source of insights into variations of conventional textbook treatments.

Clark Edwards

Techniques for Project Appraisal Under Uncertainty

By Shlomo Reutlinger. The Johns Hopkins Press, Baltimore. 95 pages. 1970. $3.

The problem of formulating an optimal investment plan composed of investment projects whose outcomes depend on "risky" or "uncertain" parameters and variables is a form of decision under risk and uncertainty. Several theories have been developed which assume differing forms of "rational behavior" under risk and uncertainty on the part of decision makers. These theories suggest methods of solving the decision problem consistent with the behavior assumed. Although real-world decision makers may behave in manners assumed by any one of the theories, in practice they do not employ the methods suggested because (1) they are not aware of them and (2) they lack the specialized knowledge to understand and employ them. Reutlinger's monograph is an attempt to acquaint the real-world decision maker with the subjective probability approach to decisions under uncertainty, and to render the methods suggested by this approach into usable tools.

The appraisal of an investment plan begins with the evaluation of the individual project proposals. Reutlinger devotes a considerable amount of time to the questions of what information these evaluations should include, how they should be derived, and how they should account for variables whose values are uncertain. Basically his conclusions are these:

(1) Evaluation of an investment project should be based on an estimate of the distribution of net benefits. The mean and variance of the estimate are indicators of outcome and risk. The computation of the expected value, or any single value estimate of net benefits alone, does not give any indication of the risk involved. The computation of limits alone, between which the actual net benefit will almost surely lie, does not indicate the most likely value. Frequently the limits are so broad as to include many unfavorable returns and to render the estimates of aggregate net benefits to an investment plan too broad.

(2) Since an estimate of the distribution of net benefits is required, an evaluation is best derived by estimating the joint probability distribution of all variables and parameters. The corresponding distribution of net returns is then derived with the aid of a mathematical model of the project.

(3) When the distribution of probable values for a variable or parameter is unknown, subjective estimates should be substituted since this action is consistent with observed behavior. Reutlinger proposes several methods for deriving a "subjective" probability distribution of a variable or parameter whose outcome is uncertain.

The bulk of the monograph is devoted to considering two feasible methods of deriving the estimated probability distribution of net benefits. There are now available computer programs which, given the model and the distributions of the variables and parameters, construct estimates of the distribution of returns. The use of the computer is certainly desirable if the model is complex. If the model is simple or a computer is not available, Reutlinger suggests the use of probability calculus to derive the mean and variance of returns as a proxy to the entire distribution. Although this latter technique harbors hazards which a computer can easily be programmed to avoid, Reutlinger is thorough in his analysis.

Finally, Reutlinger turns to the problem of deciding upon the composition of an investment plan or between alternative plans. In theory, the decision is a matter of maximizing the utility of aggregate returns for the individual. For the decision maker in the public sector it's a matter of maximizing a social welfare function. Unfortunately, in practice it is usually impossible to quantify either a utility or social welfare function and therefore the individual must base his decision primarily on experience and intuition. There is one other guide to project portfolio selection, which is to seek out "compensating risks." If a high percentage of the outcomes of

projects included in a plan are correlated, failure of any project will usually imply failure of all projects. In other words, you are dealing with an "all or nothing" situation. If the outcomes of projects are uncorrelated, the failure of one project will usually be compensated by the success of another. Therefore, to the degree that the decision maker can assure himself that the outcomes of projects within his plan are uncorrelated, he can have confidence in achieving the aggregate expected value.

These are in brief the major points of the monograph. Many other topical points are touched upon, including questions of the value of additional information, timing, model structure, and the nature of decision problems for public officials. A weakness of the monograph is its tendency to shift focal points suddenly. The monograph is aimed at the level of those familiar with the problems of investment decision, however, and therefore such shifts should not prove too unsettling to the reader.

The reviewer (and Reutlinger in his monograph) intends to steer clear of questions of conflicting methodology implied by the several theories of rational behavior in the decision process under uncertainty. However, readers should be aware that there are other solutions to the problem, including game and Bayesian strategies. One should not embrace Reutlinger's approach unless it is consistent with his own behavior.

John Howell

The Fiscal Revolution in America

By Herbert Stein. The University of Chicago Press, Chicago and London. 526 pages. 1969. $10.

Stein has given us an outstanding book that is informative, entertaining, and extremely current. If, for example, you are worried about the deficit in the Federal Budget probably forthcoming this quarter, a couple of nights with *Fiscal Revolution* will do you a lot of good. Not only will you view the debt in proper perspective to other national aggregates, but you will also gain an insight into the impact of an unbalanced budget upon the President, and what a Chief Executive is likely to do or not do when red ink appears. You get all of this in readable detail.

Writing before his present appointment to the Council of Economic Advisers, the author candidly traces the slow, awkward acceptance by both political parties of the principle of managing Government expenditures and taxes to help insure economic growth and price stability. The Keynesian contention that a planned budget surplus or deficit will have multiple effects upon private investment and consumption has been acknowledged almost universally by the economic community. A defense contractor in a depressed area receives funds from the Air Force; pays his subcontractors, employees, and stockholders. These recipients, in turn, buy (after saving a certain portion) supplies, food, automobiles, clothes, and so forth. At each stage of transfer, someone's expenditure becomes another's income until at last the exchange becomes minute and the ripples caused by the big expenditure fade. Ideally, everyone gains because they have worked using their skills and facilities, expanding and creating productivity and capacity.

Although the Congress and the Administration during the past 40 years may have logically accepted the multiplier and the accelerator, in their hearts they knew there was something un-American about the whole idea. In looking at the national budget, it is extremely difficult to divorce one's personal experience that the family budget should not exceed immediate income for any sustained period. Even Franklin Roosevelt, breaking with all precedents in seeking to rescue the 12 million unemployed of the depression, failed to a great extent because he constantly sought to return to fiscal "respectability." Not until World War II did the Nation spend enough to achieve his goal.

Because of his long association with the Committee for Economic Development, Stein is at his best in explaining the role of business in fiscal policy. Businessmen's confidence is essential in any attempt to curb inflation or to stimulate investment over the long run. The tax reduction promised by President Kennedy in 1962 and signed into law by President Johnson in 1964, commonly viewed as the final defeat of budget balancing, was actually a sort of marriage between conservatives and those who felt government has a responsibility to promote economic growth for the general welfare. It marked a situation in which industrial statesmen recognized the advantages of stimulating the economy by releasing funds to the private sector. The tax cut has the ability to increase purchasing power immediately, while expenditures must be carefully processed to achieve the best effect. But best of all, the tax cut is something that industry and the financial world can utilize.

Unfortunately our book leaves us at the peak of fiscal success, 1964, when all economic indicators are pointing upward and price acceleration has yet to make its dramatic appearance. Economists are glowing and "fine-tuning" is in vogue. But beginning in 1965, materials, manpower, and money have become scarce and increasingly expensive as costs soar. After several critical years, the President and the Congress finally agreed in 1968 to a cut in proposed expenditures and a 10 percent surtax,

illustrating the administrative and political difficulties that makers of fiscal and monetary policy face.

In 1970 we are faced with a double task: (1) Curb the inflation caused by our overexpansion and rigid cost structure and (2) increase the productivity of our workers and facilities. Can monetary and fiscal measures accomplish this minor miracle without severe unemployment? This is the book we'll want to read. It will be very interesting to see how Stein describes his own years of Council duty. If he does as well as he has in *Fiscal Revolution*, the book should be a best seller.

Meyer J. Harron

Change in Agriculture: The Northern United States, 1820-1870

By Clarence H. Danhof. Harvard University Press, Cambridge. 322 pages. 1969. $10.

The five decades from 1820 to 1870 brought tremendous changes to agriculture in the Northern States. This was the period during which the United States emerged from an agricultural economy to an industrial economy. And within agriculture the transition was made from subsistence to commercial farming.

Clarence Danhof, an economist, has used a different approach in his treatment of this important period. His is essentially an interpretative study rather than a chronology of change. He focuses on problems, functions, ideas, and successful solutions rather than on individual farmers or personalities. Thus his chapters deal with the changing environment, the growth of marketing institutions, sharing and expanding the fund of knowledge, prerequisites for farming, acquiring title to a farm, management of the farm enterprise, reaction to improved implements, and utilization of the soil.

Productivity of modern American agriculture has its roots in changes in motivation, technology, and institutional organization that have had cumulative effects beginning in the early part of the last century. Basic to the whole gamut of change from subsistence to commercial agriculture was an acceptance of agriculture as "market-focused, profit motivated," characterized by a "rational approach to technology." Such a process was sporadic, influenced by expanding knowledge of methods, improved implements, and livestock.

Acceptance of change was slow, conditioned to some extent by physical factors. However, events outside of agriculture, such as transportation improvements, growing urban population, and expansion of external markets, had their impact. "Big farming" became a question of net income rather than number of acres cultivated. Conversely, industrial developments were fostered by the growth of commercial agriculture, and in turn contributed to agricultural improvements.

By the beginning of the Civil War, agriculture as well as industry, in the Northern States, had progressed to the point where it was able to meet the challenges and increased demands of this crisis. The war years also saw the passage of four laws that were to have ever-increasing impact on agriculture in the years ahead--the Land-Grant College Act, fostering agricultural colleges; the Pacific Railway Act; the Homestead Act; and the Act establishing the Department of Agriculture.

As the Nation readjusted to production for its peacetime market, criticism of marketing facilities continued. There is little information in this study on the postwar period. Of lesser importance to the general story are a few factual deficiencies that probably only a specialist would find. For example, many of the early Hussey reapers were custom made in barns of plantation owners; and the Advisory Board on Agriculture of 1859 had little direct impact, aside from its representation of developing ideas.

The study is well documented, with many explanatory footnotes that add much to the narrative. The extensive bibliography reflects careful research and provides a stepping stone for those seeking further information.

Anyone interested in the factors underlying developments in American agriculture will find *Change in Agriculture: The Northern United States, 1820-1870*, of value. Danhof has provided a case study for historians, economists, and specialists in the economic problems of developing countries, from which they can profit.

Vivian Wiser

Soviet Agriculture in Perspective—A Study of Its Successes and Failures

By Erich Strauss. Frederick A. Praeger, Inc., New York, Washington. 328 pages. 1969. $8.50.

Die Landwirtschaftlichen Betriebsgrossen in der Sowjetunion in Statistik und Theorie (The Optimum Size of Farms in the Soviet Union in Statistics and Theory)

By Ivan Loncarevic. Osteuropastudien der Hochschulen des Landes Hessen, Reihe I, Band 45, Otto Harrassowitz, Wiesbaden (West Germany). 184 pages plus maps. 1969. (No price.)

Les Marches Paysans en U.R.S.S. (The Peasant Markets in the USSR)

By Basile H. Kerblay. Mouton & Co., Paris. 517 pages. 1968. (No price.)

Despite the great outpouring of scholarship on Soviet agriculture in the past few decades there are few good, and no current, general surveys of the subject. Naum Jasny published his monumental *The Socialist Agriculture of the USSR* (Stanford) in 1949, and Lazar Volin published his *A Survey of Soviet Russian Agriculture* (USDA) in 1951. These two works, based largely on materials available before the Second World War, were landmarks which are still used extensively.

Since Jasny and Volin published their books major changes have taken place in Soviet agriculture, and since 1958 there has been a great outpouring of statistical and other published material. These developments have produced a wealth of journal articles and compendia, but no general surveys.

This void Strauss has filled with a smooth and comprehensive overview of Soviet agriculture from 1917 to the present. Specialists will find little in Strauss' book which is new, and they might find some points to argue with. But the general reader will be grateful for this readable and comprehensive survey. Strauss' exposition is generally well balanced and noncontroversial.

The book is divided into three parts. The first part, "Starting Points," sets forth some of Strauss' general observations on Soviet agriculture. Of these the most important are the following:

1. The recognition, which most objective students must now accept, that "*compulsory* collectivization" was "a major social and economic catastrophe" (p. 22). This has not been recognized in official Soviet dogma, but much of Soviet agricultural policy since 1932 has been an attempt to overcome the impact of this ill-conceived and ill-executed policy.

2. The terrible burden placed on Soviet agriculture by the USSR's policy of forced industrialization in an extreme isolationist context (p. 26). This industrialization in a predominantly agricultural economy presupposed increases in agricultural productivity; but compulsory collectivization, with the object of extracting a "surplus" from agriculture, produced exactly the opposite effect. This situation does much to explain the special significance of agriculture in the Soviet economy.

3. Bureaucratic dictatorship, as Strauss notes, produced the tendency toward "sweeping campaigns" (p. 39), which has typified Soviet agricultural policy. Because no one dares to be out of phase with existing dogma, policies have usually been pushed to unrealistic extremes to the detriment of agricultural progress.

The second part, "The Past," is a chronological history of Soviet agriculture from 1917 to the present. There is little new or argumentative in these chapters, which deal successively with the period of "War Communism and the NEP" (1917-28); the period of collectivization and its aftermath (1925-40); the period of "War, Recovery, and Stalemate" (1941-53); the "Krushchev Era" (1953-64); and "after Krushchev."

The reader unfamiliar with these events will find a good general review of the aftermath of the First World War and the Revolution, the period of the New Economic Policy (NEP), and the factors which led to the decision to collectivize—the desire to gather from agriculture everything above subsistence at no price or a nominal price, and to gain complete control over the peasant economy. The aftermath of this policy—the drop in total grain production but a rise in grain available to the government, and the heavy slaughter of livestock—is described. The slow recovery to 1940 and the heavy losses during the war are also covered.

With agricultural output at the time of Stalin's death in 1953 still below the level of 1913, Strauss states Khrushchev's dilemma well, and describes his efforts to gain quick results from agriculture to feed a rapidly growing industrial economy. He gives Khrushchev his due for transforming Soviet agriculture from a harshly exploitive, nonmonetary system to one which is largely monetized and partly rejuvenated by capital investments and increased incentives.

He also outlines the crucial elements of the new agricultural policies of Brezhnev and Kosygin which helped to produce the rapid recovery of Soviet agriculture during 1966-68.

In the last part of the book, "Problems and Prospects," Strauss deals with four important issues: (1) How much agricultural produce does the Soviet Union need? (2) How much agricultural investment does the Soviet Union need? (3) How high are Soviet prices and costs? and (4) Are Soviet farms too large? These are rightly seen by Strauss to be the most critical questions one should ask about Soviet agriculture today, but I feel this is where the book is weakest, and where specialists would tend to argue the most with Strauss' conclusions.

Strauss says (p. 245-50) that although the diet is low in quality it is adequate, which is true. I think, however, that he understates the need for improvement. It is often hard to comprehend the magnitude of changes necessary to make significant improvements in the Soviet diet. The average Soviet citizen will not draw much satisfaction from the output projections by FAO and others which Strauss cites, nor the production plans announced by the USSR for 1971-75.

The need for additional investment in Soviet agriculture is stressed by Strauss. I agree very strongly on this point, but many students of the subject would not.

Although Strauss' treatment of the relative cost of agricultural production is not extensive his major points, if I understand them correctly, are valid.

By comparison with the United States, Soviet agricultural costs are high, but this distortion is diminished by other international comparisons. Strauss correctly notes the very low labor productivity of Soviet agriculture, due largely to the heavy dependence on labor in a country with great seasonal fluctuations, and where a large part of the labor force consists of old people, women, and children not yet able to escape to the cities. The absence of adequate capital, low incentives, and no real room for the play of market forces all contributed to this situation.

Although the problem of optimal farm size in the Soviet Union is a difficult one, Strauss seems unnecessarily vague about this issue. He is undoubtedly correct in attributing the gigantic Soviet state farms and collective farms to shortages of management and technical talent, rather than any serious economic consideration.

He also has a good point in suggesting that the American family farm in the economic, political, and social context in which it has grown up and operates is not a good yardstick for measuring the optimal size of farms in the USSR.

But this does not clarify the question posed by the authors—are Soviet farms too large. They clearly are, as most specialists would agree and as the Soviet leadership seems to imply by the substantial decline in average farm size since 1966.

On the subject of the optimal size of farms in the USSR, the specialist who reads German will find the book by Loncarevic interesting. It is a detailed geographic and statistical study of the structure of farms in the USSR. It has the disadvantage of being primarily concerned with Soviet methods of determining the optimal size of farm rather than developing an analysis of the subject itself. For the specialist on Soviet agriculture, however, the book is useful.

Both the specialist on the USSR and the interested reader, if he reads French, will find Kerblay's *Peasant Markets in the USSR* invaluable and interesting. This book is obviously the product of extensive and careful research on a subject of great significance to Soviet economic life. Despite its significance, however, it has received little attention.

The peasant markets were of great importance in Russia and Kerblay provides some of this history. Despite heavy pressures after 1917, the peasant markets survived and to a very great extent provided the safety valve which made it possible for the clumsy Soviet planned economy to survive.

Kerblay describes in detail the kinds of peasant markets and their geographical location. He describes and analyzes the historical development of peasant markets in Russia and in the Soviet Union from the 19th century through the early 1960's. He devotes considerable time to the collective farm markets in the USSR which have been, and still are, a major source of quality fruits, vegetables, and livestock products to the rural and urban Soviet consumer; and a major source of income to Russian farm workers whose incomes from their work on state and collective farms have seldom been adequate.

With the advancement of Soviet economic and industrial growth, state retail stores have grown greatly in the distribution of goods to consumers. This has diminished the relative role of peasant markets, but they are still significant. The large increase in farm incomes which has resulted from the higher prices and increased farm sales to the government in the past decade and a half have diminished the relative significance of the peasant (collective farm) markets as a source of farm income. This source is still quite significant, however, and the collective farm markets still account for a large share of the retail sales of livestock products, fruits, vegetables, and potatoes.

Harry E. Walters

The Agricultural Development of Venezuela

By Louis E. Heaton. Frederick A. Praeger, Inc., New York. 350 pages. 1969. $15.

In common with women's dress lengths, this book was obsolescent before it was published. According to the foreword, the study was made during 1966 and 1967, but the publication date is 1969. Using data no later than 1965 for analysis purposes compounds this difficulty.

The 5-year period 1961-65 shows Venezuelan agricultural production growing at a rate of only 4.4 percent because 1961, which saw a 6 percent fall, is included. Agricultural production for the 10-year period 1960-69 rose at a rate of 5.6 percent. Thus the constraints of the time period provide the author with an analytical base that forces relatively pessimistic conclusions.

Heaton was an important contributor as a technical adviser in the preparation of *Long Term Forecasts of the Supply and Demand of Agricultural and Livestock Products in Venezuela*, prepared under contract with the Economic Research Service, and issued in 1965. He draws heavily upon that study for certain projections, as, for example, the total income of the Venezuelan

petroleum industry in relation to the total fiscal income of the Venezuelan Government. The study is, however, not mentioned in the volume.

The author provides a series of interesting and useful tables on agricultural progress. Table 82 detailing changes in crop production methods is a good case in point. The tables are properly labeled as subjective evaluations, but they are very useful and on the whole, stand up well to a 5-year test.

While the middle sections of the book are flawed, more often than not by the 1965 cut-off date which antedates, for example, the rapid increase in sugar exports, the final sections continue to be valid. The author has a sound understanding of factors impeding agricultural growth in Venezuela, and by extension most Andean countries.

The last chapter is the best in the book. Here the author brings out basic problems and provides his ideas as to their solution. He shows that the lack of cadastral survey work, labor skills, and a civil service law have cost Venezuela severly in agricultural development.

Some of his solutions, such as land tenure changes based on commercial-size farms, are not currently popular, but he makes good arguments in favor of his position.

The Agricultural Development of Venezuela is not a "benchmark" work on Venezuelan agriculture. Nonetheless, it provides a good picture of Venezuelan agriculture from 1961 to 1965, and seen in that light is a satisfactory piece of work.

John McAlpine

Tropical Agriculture: The Development of Production

By Gordon Wrigley. Frederick A. Praeger, Inc., New York. 363 pages. 1969. $13.50.

This latest edition of a general book on tropical agriculture is a most useful and effective guide to the development of tropical crops, livestock, and pastures, as well as subsistence crops. It has something of value for all who work in or are interested in tropical agriculture, whether in Africa or America, or in such crops as coffee, sugar, cacao, tea, corn, and rice. This book is the most effective and understandable one the reviewer has known in more than a quarter of a century of tropical experience and background. There is now need for an equally effective book from the social science viewpoint to further narrow the gap between the natural scientist and social scientist interested in increasing productivity in the tropics.

This book clearly presents for the nonspecialist the technical background on tropical crops and livestock, including some unique and useful charts and tables on subsistence crops and livestock management and pastures in the tropics. These tables, the livestock section, and the brief but comprehensive bibliography are alone worth the price of the book. The author strongly suggests also that local research studies be consulted on specific crops and problems.

A brief listing of the general contents indicates the practical use of the present book: Crop ecology—soils, tropical rainfall, solar radiation, cover crops; crop culture—agricultural systems, crop rotation, cultivation, planting, soil and water conservation, fertilizer, irrigation, harvesting, and processing; crop improvement, including up-to-date analyses of problems and recent achievements; crop protection; and lastly, the place of cattle in tropical agriculture, the tsetse fly, pastures, and legumes. There is a useful glossary of soil terms for the nonspecialist. There are few gaps in the bibliography. It includes references to such United States authorities as Charles E. Kellogg, E. F. Knipling, W. O. Jones, Frederick L. Wellman, A. O. Rhoad, George Sprague, and Bruce F. Johnston. It also refers to the summary publication on coffee around the world by C. A. Krug, the eminent Brazilian coffee specialist.

It is hoped that revised editions may include additional material on Brazil, crop diversification, and improvements in the American tropics, and more on crop improvement work by the staffs of the Rockefeller Foundation and local governments cooperating in Latin America, Africa, and Asia. If a revised edition is issued, it should also include references to recent accomplishments in corn improvement work in Kenya, to corn as an export crop in Thailand, and to the progress being made in improving millet and grain sorghum production in India and Africa.

Robert C. Moncure

Sorghum

By H. Doggett. Humanities Press, Inc., New York. 403 pages. 1970. $20.

The latest addition to the "Tropical Agriculture Series," published in London by Longmans and handled in the United States by the Humanities Press, adds to the value of the series. Economists will find the first chapter on the History, Origins and Classification of Sorghum and the eighth chapter on the Utilization of Grain Sorghum particularly helpful.

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